

DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY

Department of Microbiology

«APPROVED»

The first vice-rector for scientific and
pedagogical work

Professor M.R. Chzegotsky, MD



2021

WORKING CURRICULUM OF DISCIPLINE

MICROBIOLOGY WITH BASICS OF IMMUNOLOGY

preparation of specialists of the second (master's) level of higher education

in the field of knowledge 22 "Health care"

in the specialty 226 «Pharmacy»

Discussed and approved
on the methodical meeting
of the department of microbiology
Protocol No 1
dated 30 August 2021
Head of the department
O.P. Korniychuk, MD

«APPROVED» at the sitting of the
cyclic methodical commission
on the preventive medicine
Protocol No 5
dated 16 September 2021
Head of the commission
Professor V.I. Fedorenko

Lviv 2021

The program is elaborated by:

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| № | Content of changing | Data and № of protocol from meeting of the department | Annotation |
|---|--------------------------|---|------------|
| 1 | No changes had been made | Protocol No 1 dated 27 August 2021 Protocol No 5 dated 16 September 2021 | |

Explanatory Note

The program of study of the discipline "Microbiology with the basics of immunology" is made in accordance with the draft Standard of higher education of Ukraine of the second (master's) level of higher education in the field of knowledge 22 "Health" specialty 226 "Pharmacy, industrial pharmacy" discussed at the XIII All-Ukrainian scientific-practical conference with international participation "Topical issues of quality of medical education" (May 12 - 13, 2016, Ternopil) and an approximate curriculum for training specialists of the second (master's) level of higher education in the field of knowledge 22 "Health" in higher education institutions of the Ministry of Health Of Ukraine in the specialty 226 "Pharmacy" qualification educational "Master of Pharmacy", approved on 07/26/2016. at. Minister of Health V. Shafransky; taking into account the Instructions for assessing the educational activities of students in the implementation of the European credit transfer system for the organization of the educational process, approved by the Ministry of Health of Ukraine on 15.04.2014.

According to the curriculum, the discipline "Microbiology with the basics of immunology" is studied by students of the second and third year of study and is based on the knowledge gained by students in medical biology, medical and biological physics, general biology, botany, biological chemistry, bioorganic chemistry, physiology and integrates with these disciplines. The discipline "Microbiology with the basics of immunology" lays the foundation for students to study general hygiene, epidemiology, pathological physiology and other disciplines, which involves the integration of teaching with these disciplines and the application of knowledge of microbiology, virology and immunology in further study and professional activities

The discipline "Microbiology with the basics of immunology" is taught during two (IV, V) semesters:

Semester IV. Morphology and physiology of microorganisms. Infection. Immunity. General and special virology. Bioprotection and bioterrorism.

Semester V. Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of drugs in the conditions of pharmaceutical production and pharmaceutical enterprises.

Types of educational knowledge according to the curriculum are: a) lectures, b) practical classes, c) self-education work of students

The topics of the lecture course reveal the problematic issues of the relevant sections of microbiology.

Practical classes according to the method of their organization are laboratory, because they provide:

1) research by students of the morphology and structure of bacteria, serological reactions, experiments on cell cultures, animals and chicken embryos, or on the basis of experiments recorded in videos, movies presented in computer programs and other educational technologies;

2) solving situational problems (laboratory diagnostics of infectious diseases, assessment of immunity indicators, sanitary-microbiological assessment of the state of the environment, etc.), which have experimental, clinical-diagnostic or sanitary-hygienic direction.

It is recommended that students in practical classes briefly write down the protocols of research, indicating the purpose of the study, the name of the method, the course of work, research results and conclusions.

The current learning activities of students are monitored in practical classes in accordance with specific objectives. The following level diagnostic tools are used preparation of students: testing, written or oral answer to control questions, solving situational problems, conducting laboratory research and interpretation and evaluation of their results, control of practical skills.

Assessment of student achievement in the discipline is a rating and is set on a multi-point scale as the arithmetic mean of the mastery of the relevant modules and is determined by the ECTS system and the scale adopted in Ukraine.

The subject of study of the discipline is the properties of pathogenic representatives of the world of microbes, their interaction with the human body, the mechanisms of development of infectious diseases, methods of their diagnosis, specific prevention and treatment.

Interdisciplinary links: - The study of "Microbiology with the basics of immunology" is directly based on the following disciplines: medical biology, medical and biological physics, general biology, botany,

biological chemistry, bioorganic chemistry, physiology.

1. The purpose and objectives of the discipline

1.1. The purpose of studying microbiology, virology and immunology - the ultimate goals are set on the basis of the OPP of pharmacist training in the specialty in accordance with the block of its content module (natural - scientific training) and is the basis for building the content of the discipline. The description of goals is formulated through skills in the form of target tasks (actions). Based on the ultimate goals for each content module, specific goals are formulated in the form of certain skills (actions), target tasks that ensure the achievement of the ultimate goal of studying the discipline.

1.2. The main tasks

☐ Interpret the biological properties of pathogenic and non-pathogenic microorganisms, viruses and patterns of their interaction with the macroorganism, human population and the environment.

☐ To determine methods of microbiological and virological diagnostics, etiotropic therapy and specific prevention of infectious diseases.

☐ To interpret the main mechanisms of formation of the immune response of the human body.

☐ To determine methods of immunotherapy and immunoprophylaxis of infectious diseases.

☐ Interpret the results of microbiological research of medicines in the conditions of pharmacy production and pharmaceutical enterprises.

1.3. Competences and learning outcomes, the formation of which is facilitated by the discipline (relationship with the normative content of training of higher education, formulated in terms of learning outcomes in the Standard).

According to the requirements of the standard, the discipline provides students with the acquisition of competence:

- *integrated*: - Ability to solve typical and complex specialized problems and practical problems in professional activities in the field of health care, or in the learning process, which involves microbiological research and / or innovation and is characterized by complexity and uncertainty of conditions and requirements;

- *general*: - Ability to apply knowledge in practical situations. Ability to exercise self-regulation, lead a healthy lifestyle, ability to adapt and act in a new situation. Ability to choose a communication strategy; ability to work in a team; interpersonal skills. Skills in the use of information and communication technologies. Ability to abstract thinking, analysis and synthesis, the ability to learn and be modernly trained. Definiteness and perseverance in terms of tasks and responsibilities. Ability to act socially responsibly and with public awareness. The desire to preserve the environment. Universal competencies that do not depend on the subject area, but are important for the successful further professional and social activities of the applicant in various fields and for his personal development.

- *special (professional, subject)*: - Ability to evaluate the results of laboratory and instrumental research. Ability to carry out sanitary and hygienic and preventive measures. Ability to plan preventive and anti-epidemic measures for infectious diseases. Ability to process state, social, economic and medical information. Ability to assess the impact of socio-economic and biological determinants on the health of the individual, family, population. Ability to apply scientifically based psychological techniques of effective work with colleagues, medical staff, patients and their relatives, willingness to interact with other people. Awareness of the individual in the culture of other peoples.

List and content of competence

| N | List of competencies | Content competence | Types of competence | | |
|---|----------------------|--|---------------------|---------|---------|
| | | | Integral | General | Special |
| 1 | Communicative | Integration capacity, based on the humanistic qualities of the individual and aimed at ensuring the effectiveness of communicative activities, due | | | + |

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| | | to the experience of interpersonal communication of the individual, the level of his education, upbringing and development | | | |
| 2 | Cognitive | The level of individual cognitive activity, which corresponds to the existing system of principles, values, methods of cognition in the culture of society | | + | |
| 3 | Intellectual | A special type of knowledge organization that provides the ability to make effective decisions, including in extreme conditions | | | + |
| 4 | Intellectual and corporate | A complex psychological property of person, characterized by a set of skills and abilities adequate to the importance of optimization tasks | | + | |
| 5 | Information | The ability of an individual to apply, find, store and convert various information. This is the ability to work with different information systems. | | | |
| 6 | Technological | The system of creative and technological knowledge, abilities and stereotypes of activity on transformation of objects of medical reality by means of technical means | | | + |
| 7 | Culturological | The ability of the individual to organize an integrated humanitarian educational space, the formation of a single image of culture or a holistic picture of the world | + | | |
| 8 | Psychological | A structured system of knowledge about man as a person, a subject of labor and personality, involved in individual or joint activities, carries out professional or other interactions. | | | + |
| 9 | Psychological medicine | The set of certain qualities (properties) of the individual with a high level of readiness for medical activities and effective interaction with patients in the health process | | | + |

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| 10 | Professional | Qualitative characteristics of the degree of mastery by professionals of their professional activities, which includes: awareness of their motivations for this activity, assessment of their personal characteristics and qualities, regulation of their professional development, self-improvement and self-education | | | + |
| 11 | Social and psychological | Possession of scientifically-based psychological methods of effective work with colleagues, medical staff, patients and their relatives, readiness to interact with other people. | + | | + |
| 12 | Common cultural | Awareness of the individual in the culture of other peoples | + | | |
| 13 | Conflict logical | Professional awareness of the range of possible strategies of conflicting parties and the ability to provide psychological and technological assistance in the implementation of constructive interaction in a particular conflict situation. | | + | |
| 14 | Design / prognostic | Skills needed to determine the tactical and strategic objectives through the achievement of which the professional process is implemented. | | | + |
| 15 | Information and prognostic | Constructive skills of compositional arrangement of integral knowledge. | + | | |
| 16 | Organization skills | Activity management skills. | | + | |
| 17 | Communicative | Communicative skills of influencing the subjects of the professional process | | | + |
| 18 | Analytical | Ability to adequately assess the level of their own activities. | | + | |

**Detailing of competence according to descriptors
NRC in the form of the "Competence Matrix"
"Competence matrix"**

| № | Competence | Knowledge | Ability | Communication | Autonomy and responsibility |
|----|-------------------------------|---------------------------------------|---|-------------------------------------|-------------------------------------|
| 1. | Ability to apply knowledge in | Have specialized conceptual knowledge | Be able to solve complex tasks and problems | Clear and unambiguous communication | Responsible for making decisions in |

| | | | | | |
|----|--|--|--|--|---|
| | practical situations | acquired in the learning process | that arise in professional activities | of one's own conclusions, knowledge and explanations that substantiate them to specialists and non-specialists. | difficult conditions |
| 2. | Ability to evaluate the results of laboratory and instrumental research. | Most specialized knowledge of a person, his organs and systems, to know the standard method of conducting laboratory and instrumental research (on list 4: Serologic reactions at infectious diseases; Express tests for viral diseases; Amplification methods in infectious diseases; Serological reactions in autoimmune diseases; Chemical and bacteriological studies of biological fluids and emissions). | Be able to analyze the results of laboratory and instrumental studies and, on the basis of them, to evaluate the information on the patient's diagnosis (on the list 4) | It is substantiated to assign and evaluate the results of laboratory and instrumental studies (Schedule 4). | Be responsible for making decisions on evaluating the results of laboratory and instrumental studies |
| 3. | Ability to plan preventive and anti-epidemic measures on infectious diseases | To know the principles and systems of planning preventive and anti-epidemic measures in relation to infectious diseases in typical conditions and in conditions of epidemic illness on the basis of the results of the | To be able to work on the basis of epidemiological analysis, using preventive and anti-epidemic methods, to plan (draw up plans) measures to prevent the spread of infectious diseases (in list 2) | Inform the population, heads of relevant institutions and enterprises on the timely conduct of preventive and anti-epidemic measures, vaccinations, etc. | To be responsible for qualitative analysis of indicators of infectious morbidity of the population, timely carrying out of appropriate preventive and anti-epidemic measures. |

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| | | analysis, data of the survey of the cell of infectious diseases. Know prophylactic and anti-epidemic methods of organizing measures to prevent the spread of infectious diseases. | | | |
| 4. | 4. Ability to carry out preventive and anti-epidemic measures in relation to infectious diseases. | Know the principles of organizing and conducting a system of preventive and anti-epidemic measures in relation to infectious diseases and preventing their spread in typical conditions and during an exacerbation of the epidemic situation. Know the methods of detection and early diagnosis of infectious diseases, organization of primary anti-epidemic measures in the cell of infectious diseases. | To be able to organize preventive and anti-epidemic measures in relation to infectious diseases in a health facility, among the assigned population and in cells of infectious diseases on the basis of epidemiological analysis according to risk groups, risk areas, time and risk factors. | Inform the leaders of the health care institutions, local authorities on the epidemic situation and the need for timely and qualitative prevention and anti-epidemic measures in the health care facility, among the assigned population and in the cells of infectious diseases. | To be responsible for the quality and timeliness of early diagnosis of infectious diseases, the organization of effective preventive and anti-epidemic measures to prevent the spread of infectious diseases. |
| 5. | Ability to process state, social, economic and medical information | Know standard methods, including modern computer information technologies, processing of state, social and medical information | Ability to determine the source of finding the necessary information depending on its type; the ability to perform statistical processing of the material and | Form conclusions based on the analysis and statistical processing of the information received | To be responsible for the quality and timely implementation of statistical processing and analysis of the information obtained |

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|----|--|---|--|---|---|
| | | | analysis of the information obtained | | |
| 6. | Ability to assess the impact of socio-economic and biological determinants on the health of the individual, family, population | Know the socio-economic and biological determinants that affect the health of the population; types and methods of prevention to prevent the negative impact of socio-economic factors on the health of the population and its individual groups. | To be able to calculate health indicators based on data of epidemiological and medical-statistical researches Be able to assess the relationship and the impact of socio-economic and biological factors on the health of the individual, family, health population Be able to plan preventive measures to prevent the negative impact of socioeconomic factors on the health of the population and its individual groups. | To obtain the necessary information from identified sources regarding the health status of the population and its individual groups and to formulate conclusions on the impact of socio-economic and biological factors on health. population | To be responsible for the justification of preventive measures to prevent the negative impact of socio-economic factors on the health of the population and its individual groups |
| 7. | Ability to apply intellectual abilities and knowledge while working with a patient. | Know the ideological function of bioethics in the formation of a civil society and the historical aspects of the concept of "human rights". | Be able to identify potential threats to the essence of living organisms. | Get the necessary medical, social, special information. | Take effective decisions, including in extreme conditions and bear responsibility for them |
| 8. | Ability to provide medical-ethical and legal assessment of specific cases from the standpoint of confidentiality | Know the Law of Ukraine "On the counteraction to the spread of diseases caused by the human immunodeficiency virus (HIV), the legal and social | Take into account the varieties of human rights and citizen | Apply the norms and principles of biomedical ethics and deontology | To bear responsibility for the preservation of medical secrets. |

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| and medical secrecy in solving situational problems in patients with HIV infection. | protection of people living with HIV. | | | |
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Learning outcomes:

Integrative final program learning outcomes, the formation of which is facilitated by the discipline:

- Ability to analyze the biological properties of pathogenic and non-pathogenic microorganisms, viruses and patterns of their interaction with the macroorganism, human population and the environment.
- Ability to interpret the main mechanisms of formation of the immune response of the human body.
- Ability to identify the main types of pathological reactions of the immune system and the relationship with the most common human diseases.
- Ability to determine methods of microbiological and virological diagnosis, etiotropic therapy and specific prevention of infectious diseases.
- Ability to process state, social, economic and medical information.

Learning outcomes for the discipline - a set of knowledge, skills, abilities, other forms of competence acquired by a person in the learning process in accordance with the standard of higher education, which can be identified, quantified and measured.

According to higher education standards, students must:

Know:

In a medical institution, using a standard procedure, using knowledge about the person, his organs and systems, based on the results of laboratory and instrumental studies to assess information about the diagnosis (according to list 4):

- Serological reactions in infectious diseases;
- Microbiological study of biological fluids and secretions;
- Chemical, organoleptic, bacteriological study of food and water quality;

Be able:

- Evaluate the results of laboratory and instrumental studies on list 4;
- Anticipate the negative effects of dangerous factors on the human body;
- Master modern methods of microbiological research in infectious diseases;
- Analyze the principles of obtaining vaccines, methods of their standardization and control, practical use;
- Master the principles of production of immune sera, methods of their standardization, control, practical significance;
- Interpret the development of medicine in historical retrospect;
- Interpret the main historical and medical events;
- Demonstrate mastery of moral and ethical principles of attitude to a living person, his body as an object of anatomical and clinical research.
- create and comply with the requirements of asepsis, sanitation and safety in the workplace in the manufacture of medicines in pharmacies and pharmaceutical companies.
- Assess the sanitary condition of sanitary facilities, identify facts that contribute to the emergence and spread of diseases and injuries.
- Analyze microbiological indicators of microbial contamination of drugs.

2. Information volume of the academic discipline

150 hours of 5.0 ECTS credits are allocated for the study of the academic discipline.

Content modules 1-12: 90 hours 3.0 ECTS credits.

Content modules 13-16: 60 hours 2.0 ECTS credits.

| Structure of discipline | Number of credits, hours, from them | | | | Year of studying, semester | Type of control |
|--|-------------------------------------|------------|-------------------|----------------------|----------------------------|---------------------|
| | Total | Auditorial | Practical classes | Self education works | | |
| | | Lectures | | | | |
| Module: Microbiology with the basics of immunology Content modules 17 | 5,0 credits ECTS / 150 h. | 20 | 60 | 70 | 2-3 course (IV,V s) | credit, exam |
| by the semesters | | | | | | |
| Content modules 1-12 | 3,0 credits ECTS/90 h. | 10 | 40 | 40 | IV semester | credit |
| Content modules 13-16 | 2,0 credits ECTS/60 h | 10 | 20 | 30 | V semester | exam |

Note: 1 ECTS credit - 30 hours

Auditorial load - 53%, SEW - 47%

3. INDICATIVE STRUCTURE OF THE CREDIT LOAN - SEMES IV:

"Morphology and physiology of microorganisms. Infection. Immunity. General and special virology. Bioprotection and bioterrorism ".

| THEME | Lectures | Practical classes | SEW | Individual work |
|--|----------|-------------------|-----|-----------------|
| <i>"Morphology and Physiology of Microorganisms. Infection. Immunity. General and special virology. Bio-protection and bioterrorism "</i> | | | | |
| <i>Content module 1. Introduction to microbiology.</i> | | | | |
| Theme 1. Subject and objectives of medical microbiology. The Importance of Medical Microbiology in the Professional Activities of Pharmacists and Pharmaceutical Manufacturers. Methods of microbiological research. | 0,25 | - | - | - |
| Theme 2. Stages of microbiology development. Tasks and perspectives of development of modern microbiology. | - | - | 1 | - |
| <i>Content module 2. Morphology and structure of prokaryotes and eukaryotes. Microscopic method of diagnostics.</i> | | | | |
| Theme 3. Organization of bacteriological laboratory. Preparation of the smears. Simple methods of bacteria staining. | - | 1 | - | - |
| Theme 4. Microscopic diagnostic method. Types of microscopes. Methods of microscopy. | - | 1 | 2 | - |
| Theme 5. Complex methods of staining. Methods of Gram, Ziehl-Nielsen. | - | 2 | - | - |

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| Theme 6. Morphology and structure of prokaryotes and eukaryotes. | 1,5 | 2 | - | - |
| Content module 3. Physiology of microorganisms. Evolution, systematics and nomenclature of microorganisms. | | | | |
| Theme 7. Metabolism of bacteria. Nutrient media for the cultivation of microorganisms. | 2 | 1,5 | 2 | - |
| Theme 8. Growth and reproduction of microorganisms. Cultural properties of microorganisms. Isolation of pure cultures of bacteria (II day). | - | 2 | - | - |
| Theme 9. Enzymes of bacteria. Isolation of pure culture of aerobes in the third day. Isolation of pure culture of anaerobes. | - | 2 | 1 | - |
| Theme 10. Evolution of microorganisms. Modern taxonomy, classification and nomenclature of microorganisms. | 0,25 | - | 1 | - |
| Content module 4. Sterilization, disinfection, aseptic, antiseptic. | | | | |
| Theme 11. Microbiological bases of sterilization and disinfection. | - | 0,5 | - | - |
| Content module 5. Genetics of bacteria. Microbiological bases of genetic engineering. Biotechnology. Identification of pure cultures of microorganisms. | | | | |
| Theme 12. Genetics of bacteria. Microbiological bases of genetic engineering. Biotechnology. | 0,25 | 1 | 5 | - |
| Theme 13. Identification of the allocated pure culture of microorganisms. | - | 1 | - | - |
| Content module 6. Infection. | | | | |
| Theme 14. The role of microorganisms in the infectious process. Virulence factors. Toxins of microorganisms. Experimental method of microbiological diagnostics. | 0,25 | 2 | - | - |
| Theme 15. Infectious process. Forms of infection. Types, conditions of origin, development and spreading of the infectious process. Features of the etiopathogenesis of coronavirus infection. | 0,25 | - | - | - |
| Content module 7. Basis of immunology. | | | | |
| Theme 16. Factors of non-specific body defence. Immunology, stages of development. | 0,25 | 0,5 | - | - |
| Theme 17. Immunity. Central and peripheral organs of the immune system. Immunocompetent cells. Mechanisms of the immune response. | 0,25 | 0,5 | - | - |
| Theme 18. Cell and humoral immunity. Immune status. Allergy. | 0,25 | 1 | - | - |
| Content module 8. Antigens, antibodies. Immunity reactions. | | | | |
| Theme 19. Antigens, haptens. Antigens of microbial cell. | 0,25 | - | 2 | - |
| Theme 20. Immunoglobulins, classes, properties, functions. Monoclonal antibodies | 0,25 | - | 2 | - |
| Theme 21. Serological reactions. Serologic identification, serological diagnosis. | - | 4 | 2 | - |
| Content module 9. Immune biological drugs. | | | | |
| Theme 22. Active immunization. Vaccines, species, methods of obtaining. | - | 1 | - | - |
| Theme 23. Passive immunization and serotherapy. Preparations of immunoglobulins, types of methods of obtaining and control. | - | 1 | - | - |
| Theme 24. Immunobiological medicines. | - | - | 1 | - |
| Content module 10. Antimicrobial chemotherapy and antibiotic therapy. | | | | |

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| Theme 25. Antimicrobial chemotherapeutic agents. The main groups of disinfectants and the group of antiseptics for the prevention of COVID-19. Mechanisms of resistance development. | 2 | 2 | - | - |
| Content module 11. General virology. | | | | |
| Theme 26. The history of the discovery of viruses. Viruses, viroides, prions. Morphology and ultrastructure of viruses. Bacteriophages. Virological characteristics of the pathogen COVID-19. | 1,5 | 1 | - | Practical use of bacteriophages in microbiology and medicine. |
| Theme 27. Cultivation, Indication and Identification of Viruses. | - | 2,5 | - | - |
| Theme 28. Features of antiviral immunity. Interferon. Preparations for specific prevention and treatment of viral infections. | 0,5 | 0,5 | - | - |
| Content module 12. Special virology. | | | | |
| Theme 29. Orthomyxoviruses. | - | 2 | - | - |
| Theme 30. Paramyxoviruses. Coronavirus. | - | - | 3 | - |
| Theme 31. Picornaviruses. Virological diagnosis of acute respiratory disease COVID-19 caused by the coronavirus SARS-CoV-2. | - | 2 | - | - |
| Theme 32. Retroviruses, HIV. | - | 2 | - | - |
| Theme 33. Other RNA- genomic viruses. | - | - | 4 | - |
| Theme 34. Herpesviruses. | - | 1 | - | - |
| Theme 35. Adenoviruses. | - | 1 | - | - |
| Theme 36. Pathogens of viral hepatitis. | - | 2 | - | - |
| Theme 37. Other DNA- genomic Viruses. | - | - | 5 | - |
| Theme 38. Oncogenic viruses. Prions. | - | - | 3 | - |
| Theme 39. Biological security. Biological properties of microorganisms that can potentially be used as a bacteriological weapon. Main representatives. | - | - | 2 | - |
| Theme 40. Safety measures to prevent the consequences of bioterroristic measures. | - | - | 2 | - |
| Total hours - 90 hours. | 10 | 40 | 38 | 2 |
| ECTS credits - 3.0 | Total SES - 40 | | | |

Auditory load - 56%, SES - 44%

**ORIENTAL STRUCTURE OF CREDIT LOAN – SEMESTER V:
Special, clinical, environmental and sanitary microbiology. Phytopathogenic microorganisms.
Microbiological control of medicines in the conditions of pharmaceutical production and pharmaceutical enterprises.**

| THEME | Lectures | Practical classes | SRS | Individual work |
|--|-----------------|--------------------------|------------|------------------------|
| Content module 13. Pathogenic prokaryotes and eukaryotes. | | | | |

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|---|-----|-----|-----|---|
| Theme 1. Pathogenic cocci. | 2 | 2 | - | - |
| Theme 2. General characteristics of pathogens of intestinal infections. Escherichiosis. | 0,5 | 0,5 | - | - |
| Theme 3. Pathogens of intestinal infections. Salmonella, Shigella, Proteus, Pseudomonas aeruginosa and others. | 1,5 | 1,5 | 2 | - |
| Theme 4. Pathologists of bacterial respiratory infections (diphtheria, pertussis, tuberculosis). | 2 | 2 | 1 | - |
| Theme 5. Pathogens of especially dangerous infections (cholera). | - | 0,7 | - | - |
| Theme 6. Pathogens of especially dangerous infections (plague). | - | 0,6 | - | - |
| Theme 7. Pathogens of especially dangerous infections (anthrax). | - | 0,7 | - | - |
| Theme 8. Pathogens of zoonotic infections (tularemia, brucellosis). | - | - | 2 | - |
| Theme 9. Pathogens of gas anaerobic infection. | 0,7 | 0,7 | - | - |
| Theme 10. Pathogens of tetanus infection. | 0,6 | 0,6 | - | - |
| Theme 11. Botulism causative agent. | 0,7 | 0,7 | - | - |
| Theme 12. Syphilis causative agent. | - | 0,7 | - | - |
| Theme 13. Pathogenic spiral forms of bacteria (spirilla , Campylobacter, Helicobacter pylori). | - | - | 3 | - |
| Theme 14. Pathogens of epidemic and endemic swirling typhus. Lyme disease. | | 0,6 | - | |
| Theme 15. The causative agent of leptospirosis. | - | 0,7 | - | - |
| Theme 16. Pathogenic mycoplasmas. | - | - | 2 | - |
| Theme 17. Pathogenic Rickettsia. Pathogenic agents of epidemic and endemic typhu | - | - | 1,5 | - |
| Theme 18. Pathogens of tick-borne spotted fever, Q-fever. | - | - | 1,5 | - |
| Theme 19. Chlamydia. Origins of ornithosis, trachoma. | - | - | 2 | - |
| Theme 20. Pathogens of actinomycosis. | - | - | 2 | - |
| Theme 21. Pathogens of mycoses. | - | - | 2 | - |
| Theme 22. Pathogens of malaria. | - | - | 3 | - |
| Theme 23. Pathogens of leishmaniasis, amoebic dysentery. toxoplasmosis, trichomoniasis, giardiasis. | - | - | 4 | - |
| <i>Content module 14. Fundamentals of clinical microbiology.</i> | | | | |
| Theme 24. Clinical microbiology. Nosocomial infections. The problem of COVID-19 as a nosocomial infection. | - | 2 | 2 | - |
| <i>Content module 15. Ecology of microorganisms. Sanitary microbiology and virology. Microflora of the external environment.</i> | | | | |

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|--|-------------|-----------|-----------|------|
| Theme 25. Microflora of the external environment. | - | 1,5 | - | - |
| Theme 26. Microflora of the human body. | - | 1,5 | - | - |
| Content module 16. Phytopathogenic microorganisms. | | | | |
| Theme 27. Phytopathogenic microorganisms. | 2 | - | 2 | - |
| Theme 28. Microflora of premises of pharmacies, herbal medicinal raw materials, finished dosage forms. | - | 3 | - | - |
| Total hours - 60 hours. | 10 | 20 | 30 | |
| ECTS credits - 2.0 | | | | |
| Final | Examination | | | Exam |

Audit. work - 50.0%, CPC - 50.0%

4. Themes of lectures

| № | THEME | Hours |
|---|--|-----------|
| Semester IV. Morphology and physiology of microorganisms. Infection. Immunity. General and special virology Bio-protection and bioterrorism. | | |
| 1. | Subject and tasks of microbiology. Evolution and classification of microorganisms. Morphology and structure of bacteria. | 2 |
| 2. | Physiology of microorganisms. | 2 |
| 3. | Basics of asepsis and antiseptics. Antimicrobial chemotherapeutic drugs. The main groups of disinfectants and the group of antiseptics for the prevention of COVID-19.. | 2 |
| 4. | The doctrine of infection and immunity. Immunoprophylaxis and immunotherapy. Basis of biotechnology and genetic engineering. | 2 |
| 5. | Biological features of viruses. Cultivation. Modern classification. Features of laboratory diagnostics of viral diseases. Major groups of antiviral drugs. Virological characteristics of the pathogen COVID-19. | 2 |
| | TOTAL | 10 |
| Semester V. Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of medicines in the conditions of pharmaceutical production and pharmaceutical enterprises. | | |
| 1. | Pathogenic cocci. | 2 |
| 2. | Pathogenic Enterobacteriaceae. | 2 |
| 3. | Pathogens of respiratory bacterial infections (diphtheria, tuberculosis). | 2 |
| 4. | Pathogenic anaerobes. | 2 |
| 5. | Phytopathogenic microorganisms. Microbiological control of medicines in the conditions of pharmaceutical production and pharmaceutical enterprises. | 2 |
| | TOTAL | 10 |
| | Number of hours of discipline | 20 |

5. Themes of practical classes

| № | Topic | Hours |
|--|---|-------|
| Semester IV. Morphology and physiology of microorganisms. Infection. Immunity. General and special virology. Bio-protection and bioterrorism. | | |
| 1. | Organization of bacteriological laboratory. Dyes and simple staining methods. Basic forms of bacteria, determining of the size of microorganisms. | 2 |
| 2. | Ultrastructure of the bacterial cell. Complex methods of staining. Differential Gram staining method. Ziehl-Nielsen method. | 2 |

| | | |
|-----|--|-----------|
| 3. | Morphology and structure of bacteria. Morphology of spirochetes, actinomycetes, fungi and protozoa. | 2 |
| 4. | Physiology of microorganisms. Nutrient media for cultivating of bacteria. The first day of the isolation of pure culture of aerobic bacteria. Disinfection. Sterilization. | 2 |
| 5. | Bacteriological method of investigation. Isolation of pure culture of aerobes (second day). Cultural properties of microorganisms. | 2 |
| 6. | Isolation of pure aerobic culture on the third day. Enzymes of bacteria. Isolation of pure cultures of anaerobic bacteria. | 2 |
| 7. | Identification of pure bacterial cultures. Genetics of bacteria. | 2 |
| 8. | The role of microorganisms in the infectious process. Virulence factors. Toxins of microorganisms. Experimental method of microbiological diagnostics. | 2 |
| 9. | Factors of non-specific resistance of an organism. Immune system. Assessment of immune status. | 2 |
| 10. | Serological reactions in microbiology (AT, IHAT, PT). | 2 |
| 11. | Serological reactions (continuation) - CFT, ELISA, IFT. | 2 |
| 12. | Vaccines and immune serums. | 2 |
| 13. | Antagonism in microbes. Antimicrobial chemotherapeutic agents. Determination of bacteria sensitivity | 2 |
| 14. | Biological features of viruses. Cultivation. Microbiological aspects of COVID-19. | 2 |
| 15. | Indication of viral reproduction. Identification of viruses. | 2 |
| 16. | Orthomyxoviruses. Virological diagnosis. Preparations for specific prevention. Etiotropic treatment. | 2 |
| 17. | Picornaviruses. Virological diagnosis. Preparations for specific prevention. Virological diagnosis of acute respiratory disease COVID-19 caused by coronavirus SARS-CoV-2. | 2 |
| 18. | Pathogenic viral hepatitis. Virological diagnosis. Preparations for specific prevention. | 2 |
| 19. | DNA-genomic viruses. Herpes and Adenoviruses. Virological diagnosis of infections. Preparations for antiviral treatment. | 2 |
| 20. | Retroviruses. HIV. Virological diagnosis of HIV infection. | 2 |
| | TOTAL | 40 |

Semester V. Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of medicines in the conditions of pharmaceutical production and pharmaceutical enterprises.

| | | |
|----|---|---|
| 1. | Pathogenic cocci. Microbiological diagnostics. Preparations for prevention, treatment and diagnostics. | 2 |
| 2. | General characteristics of pathogens of intestinal infections: escherichiae, salmonella, shigella. Microbiological diagnostics. Preparations for prevention, treatment and diagnostics. | 2 |
| 3. | Pathogenic bacterial respiratory infections (diphtheria, tuberculosis). Microbiological diagnostics. Preparations for prevention, treatment and diagnostics. | 2 |
| 4. | Pathogenic agents of especially dangerous infections (cholera, plague, anthrax). Microbiological diagnostics. Preparations for prevention, treatment and diagnostics. | 2 |
| 5. | Pathogenic anaerobes. Microbiological diagnostics. Preparations for prevention, treatment and diagnostics. | 2 |

| | | |
|----|--|-----------|
| 6. | Pathogenic spirochetes, Borelia, leptospiros. Microbiological diagnostics. Preparations for prevention, treatment and diagnostics. | 2 |
| 7. | Clinical microbiology. Nosocomial infections. The problem of COVID-19 as a nosocomial infection. | 2 |
| 8. | Microflora of the external environment (water, air, soil). Microbiota of the human body. Dysbiosis and drugs for its correction. | 3 |
| 9. | Microflora of pharmacies, herbal medicinal raw materials, ready-to-use medical forms. | 3 |
| | TOTAL | 20 |
| | Total hours of practical classes in discipline | 60 |

6. Self educational work

| № | Theme | Hours | Type of control |
|--|---|-------|--------------------------------------|
| Semester IV. Morphology and physiology of microorganisms. Infection. Immunity. General and special virology. Bio-protection and bioterrorism. | | | |
| 1. | Stages of microbiology development. Modern ideas about the evolution of the microbes world. Tasks and perspectives of development of modern microbiology. | 2 | Current control in practical classes |
| 2. | Types of microscopes. Methods of microscopy. | 2 | -''- |
| 3. | Metabolism of bacteria. Protein, hydrocarbon, lipid and mineral metabolism. Practical use of enzymatic properties of bacteria. | 3 | |
| 4. | Organization of the genetic material of the bacterial cell; bacterial chromosomes, plasmids, migrating elements | 3 | -''- |
| 5. | Modifying variability, its mechanisms and forms of manifestation in bacteria. Genetic variability: mutations and recombinations. Dissociation. | 2 | -''- |
| 6. | Antigens as inductors of the immune response. Antigenic structure of microorganisms. | 2 | -''- |
| 7. | Antibodies as a product of humoral response. Classes of immunoglobulins, their structure, properties. The concept of monoclonal antibodies. Immunobiological drugs. | 3 | -''- |
| 8. | Rapid diagnostic of infectious diseases (RIA, PCR, immunoblotting). | 2 | -''- |
| 9. | Practical use of bacteriophages in microbiology and medicine. | 2 | -''- |
| 10. | Paramyxoviruses. Virus bark Parathoria, mumps Virological diagnostics, specific prevention. | 3 | -''- |
| 11. | Arboviruses. Major families and representatives (Togaviruses, Flavoviruses, Bunyaviruses, Rabdoviruses). The virus of the rabies. Virological diagnosis, specific treatment, prevention. Virus of tick-borne encephalitis. Virological diagnosis, specific and nonspecific prophylaxis. | 4 | -''- |
| 12. | Poxviruses. Virological diagnosis, treatment and prevention. | 2 | -''- |
| 13. | Papovaviruses, parvoviruses. Virological diagnosis, treatment and prevention. | 3 | -''- |
| 14. | Oncogenic viruses, viral oncogenesis Non-canonical viruses. Prions Diseases caused by them. | 3 | -''- |
| 15. | Biological properties of microorganisms that can potentially be used as a bacteriological weapon. Main representatives. | 2 | -''- |

| | | | |
|--|---|-----------|------|
| 16. | Biosecurity on the control of infections potentially dangerous as a bacteriological weapon. | 2 | -''- |
| | TOTAL | 40 | |
| <p>Semester V. Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of medicines in the conditions of pharmaceutical production and pharmaceutical enterprises.</p> | | | |
| 1. | Conditionally pathogenic enterobacteria (proteus, klebsiel, citrobacter, enterobacter). Gram-negative non-fermenting bacteria (Pseudomonas aeruginosa). Biological properties, significance in pathology, peculiarities of microbiological diagnostics of diseases. | 2 | -''- |
| 2. | Hemophilic bacteria. Bordetelie Microbiological diagnosis of a pertussis. Drugs for diagnostics, treatment and prevention. | 1 | -''- |
| 3. | Pathogenic zoonotic infections (tularemia, brucellosis). Features of epidemiology. Laboratory diagnostics. Drugs for specific prevention and treatment. | 2 | -''- |
| 4. | Pathogenic spirals. The causative agent of fever from the bite of rats. Campylobacter is a causative agent of acute intestinal diseases. Helicobacter pylori - a causative agent of human gastroduodenal diseases. Microbiological diagnostics of diseases. Modern treatments. | 3 | -''- |
| 5. | Pathogenic mycoplasmas. The role of human pathology. Laboratory diagnosis of mycoplasmosis. Drugs for treatment. | 2 | -''- |
| 6. | Pathogenic rickettsia. People of epidemic and endemic typhus. Pathogens of tick-borne spotted fever, ku-fever. Features of epidemiology. Laboratory diagnostics. Drugs for specific prevention and treatment of rickettsiosis. | 3 | -''- |
| 7. | Chlamydia. Origins of ornithosis, trachoma. Features of epidemiology. Laboratory diagnostics. Preparations for the treatment of chlamydia. | 2 | -''- |
| 8. | Pathogens of mycoses and actinomycosis. Features of epidemiology. Laboratory diagnostics. Drugs for treatment. | 4 | -''- |
| 9. | Pathogenic protozoa. Pathogens of malaria. Features of epidemiology. Laboratory diagnostics. Antimalarial drugs. | 3 | -''- |
| 10. | Pathogenic protozoa (leishmaniasis, amoeba, toxoplasma, trichomonads, lamblia). Features of epidemiology. Laboratory diagnostics. Preparations for allergic diagnosis, treatment, prevention. | 4 | -''- |
| 11. | Clinical microbiology. Features of opportunistic microorganisms and diseases that they cause. Rules for taking and transporting clinical material. Methods of microbiological research in clinical microbiology. Nosocomial infections. The problem of COVID-19 as a nosocomial infection. Hospital infections. | 2 | -''- |
| 12. | Phytopathogenic microorganisms. Features of diagnosis of plant diseases. Methods of prevention of development and control of phytopathogenic damage of herbal medicinal raw materials. | 2 | -''- |
| | TOTAL | 30 | |

7. Individual tasks

Individual tasks are performed in the form of writing research work of students on the subject of the discipline studied, within each content module.

8. Tasks for self educational work

| N | Types of self-education works | Topics of auditorial classes, which consider SEW and its control |
|---|---|---|
| | Term IV. Morphology and physiology of microorganisms. Infection. Immunity. General and special virology. Bioprotection and bioterrorism. | |
| 1 | Types of bacteriological laboratories. | Workshop №1 "Organization of a bacteriological laboratory. Dyes and simple methods of painting. The main forms of bacteria, determining the size of microorganisms " |
| 2 | Describe the mechanisms underlying the differentiated staining of microorganisms by the Gram method. | "Ultrastructure of a bacterial cell. Sophisticated painting methods. Differential method of Gram staining. The Ziel-Nielsen method. "Mechanisms according to the Gram method. |
| 3 | Morphology and structure of rickettsiae, chlamydia, mycoplasmas, fungi and protozoa. Morphological feature and classification. | "Morphology and structure of bacteria. Morphology of spirochetes, actinomycetes, fungi and protozoa. " |
| 4 | Fermentation metabolism and its products. Use in microbiology and food industry | Workshop №4 "Physiology of microorganisms. Nutrient media for the cultivation of bacteria. First day of isolation of pure culture of aerobic bacteria. Disinfection. Sterilization." |
| 5 | Methods of studying phagocytic activity: phagocytic index, opsono-phagocytic index. | Workshop №9 "Factors of nonspecific resistance of the organism. Immune system. Assessment of immune status. " |
| 6 | Genetic research methods: molecular hybridization and other new molecular genetic methods. | Workshop №11 "Serological reactions (continued) - CFT, ELISA, RIF." |
| 7 | Genetic engineered vaccines. Methods of manufacture, evaluation of efficiency and control. | Workshop №12 "Vaccines and immune sera". |

| | | |
|---|---|--|
| 8 | Morphological characteristics of bacteriophages. Characteristics of the interaction of bacteriophages with the host cell. Antiviral drugs. Mechanism of action. | Workshop №14 "Biological features of viruses. Cultivation" |
| 9 | Mechanisms of virus persistence. | Workshop №15 "Indication of viral reproduction. Identification of viruses." |
| 10 | Hemorrhagic fever viruses: Marburg, Ebola. Describe the biological properties: fill in the table. | Workshop №16 "Orthomyxoviruses. Virological diagnosis. Drugs for specific prevention. Etiotropic treatment " |
| 11 | Human coronaviruses: SARS-CoV, MERS-CoV, | Workshop №17 "Picornaviruses. Virological diagnosis. Drugs for specific prevention » |
| 12 | Students self work on the following issues 1. History of the discovery of oncogenic viruses. 2. Classification of oncogenic viruses. 3. Types of JRS in cells, characteristic of the action of oncogenic viruses. 4. The main markers of oncogenic virus in the cell. 5. Mechanisms of viral oncogenesis. Task №1 Fill in the table: "Comparative characteristics of RNA and DNA-containing oncoviruses". | Workshop № 18 "Pathogens of viral hepatitis. Virological diagnosis. Drugs for specific prevention. " |
| 13 | Indicate the reasons that contribute to the spread of epidemics in wartime. Give a comparative description of modern biological weapons. | Workshop № 19 "DNA genomic viruses. Herpes and adenoviruses. Virological diagnosis of infections. Drugs for antiviral treatment. " |
| Term V. Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of drugs in the conditions of pharmaceutical production and pharmaceutical enterprises. | | |
| 1. | Task number 1: Create a scheme of microbiological diagnosis of acute gastroenteritis: the task is written in a working notebook (protocols). Task number 2: Fill in the table "Characteristics of enterococci according to some biological properties". | Workshop №1 "Pathogenic cocci". |
| 2. | Task number 1: To create a scheme of microbiological diagnostics of diseases caused by salmonella and parahemolytic vibrios: the task is written in a working notebook (protocols). Task number 2: Fill the table with the biological properties of parahemolytic vibrios. | Workshop №2 "General characteristics of pathogens of intestinal infections: escherichia, salmonella, shigella. Microbiological diagnostics. Drugs for prevention, treatment and diagnosis. " |

| | | |
|----|--|---|
| 3. | Mycobacterium leprae. Give a description of the biological properties of the pathogen. Describe the methods of microbiological diagnosis of leprosy. | Workshop №3 "Pathogenic bacterial respiratory infections (diphtheria, tuberculosis)." |
| 4. | Clostridium difficile, describe the biological properties of the pathogen and the pathogenesis of pseudo-membranous colitis. | Workshop №5 "Pathogenic anaerobes. Microbiological diagnostics. Drugs for prevention, treatment and diagnosis. » |
| 5. | Features of cultivation of rickettsia, chlamydia. | Workshop №6 "Pathogenic spirochetes. Microbiological diagnostics. Drugs for prevention, treatment and diagnosis. » |
| 6. | Sanitary Virology. Describe the role of water, soil, air in the transmission of pathogens of viral infections. | Workshop №8 "Microflora of the environment (water, air, soil). Microbiota of the human body. Dysbiosis and remedies for its correction. " |
| 7. | Phytopathogenic microorganisms. Identify methods and drugs for controlling microbial diseases of plants. | Workshop №9 "Microflora of pharmacies, herbal medicinal raw materials, ready-made medical forms." |

9. Methods of studying

Traditional teaching methods: verbal; visual; practical.

Methods of educational and cognitive activity: explanatory-illustrative method, reproductive method, method of problem statement, partial-search or heuristic method, research method.

Methods of stimulation and motivation of educational and cognitive activity: inductive and deductive methods of learning, methods of stimulation and motivation of learning.

Methods of control as teaching methods (control by the teacher, self-control, mutual control, self-correction, mutual correction).

10. Methods of control

Current control is carried out during the study of a specific topic to determine the level of formation of a particular skill or ability, the quality of learning a certain portion of educational material by observing students' learning activities, oral interviews, written control of knowledge and skills through written work (written answers to questions, essays, solving situational problems, etc.) and test control using a set of standardized tasks.

Final control involves summarizing the results of the current control and exam.

11. Forms of final control of learning success

- Form of final control according to the curriculum (test, exam)

12. Scheme of accrual and distribution of points received by students

- Evaluation criteria

Control measures include current and final semester control and certification of graduates.

Current control is carried out at each practical lesson in accordance with the specific objectives of each topic. At each practical lesson, the student answers 5 tests on the topic of the lesson, 2 standardized questions, which include questions from the lecture course and questions from independent work; solves 1 situational problem; demonstrates knowledge and skills of practical skills in accordance with the topic of practical training.

Assessment of the current educational activity of the student.

At each practical lesson, the assessment of each student's knowledge is based on a four-point system.

Excellent ("5") - The student correctly answered 90-100% of the A format tests. He answered all the questions correctly, clearly, logically and completely. Can closely connect theory and practice, correctly demonstrates the implementation of practical skills. Freely reads the results of work, solves situational problems of increased complexity, is able to summarize the material, owns research methods to the extent necessary for the activities of the doctor. Fulfilled the planned individual work.

Good (“4”) - The student correctly answered 70-89% of the A format tests. Correctly and for essentially answered the question. Demonstrates practical skills. Right uses theoretical knowledge in solving practical problems. Able to solve easy and moderate situational problems. Has the necessary practical skills and methods of their implementation in excess of the required minimum.

Satisfactory (“3”) - The student correctly answered 50-69% of the A format tests. Incomplete, for using additional questions, answers questions. Can't build on your own a clear, logical answer. During the answer and demonstration of practical skills the student does mistakes. The student solves only the easiest tasks, has only the required minimum research methods.

Unsatisfactory (“2”) - The student answered less than 50% of the A format tests material of the current topic, can not build a logical answer, does not respond to additional question, does not understand the material. During the answer and demonstration of practical skills makes significant, gross mistakes.

At each practical lesson, students' knowledge is assessed on a four-point scale system (—5, —4, —3, —2) according to the criteria for assessing the current activities of the student. Scores on the traditional scale are converted into points.

The maximum number of points that a student can get for current educational activity per semester for admission to the exam is 120 points.

The minimum number of points that a student should get for current educational activity per semester for admission to the exam is 72 points.

Calculating the number of points is based on received by the student marks by the traditional scale while studying a subject by calculating the average arithmetic (AA), rounded to two decimal places. The resulting mark is converted into points by multipoint scale as follows: $x = AA \times 120/5$. For convenience, a table converting into 200-point scale is presented:

Independent work of students is evaluated during the current control of theme in the appropriate class. Mastering of themes which are submitted only to the independent work is controlled at the final control.

Final control is carried out to assess the results of study on a particular educational qualification level and on some of its completed stages by the national scale and scale ECTS. Final control includes semester control and students certification.

Semester control is carried out in the forms of semester exam or test (differentiated test) from a specific discipline in the volume of educational material, determined by the working program on the discipline and in terms determined by the working curriculum, individual curriculum of the student.

Semester (differentiated) test is a form of final control, which is to evaluate mastering the academic material on certain discipline by the student solely on the basis of performance of all kinds of educational works provided by the working curriculum. Semester (differentiated) test is evaluated by the results of current control.

Semester exam is a form of final control of mastering by the student theoretical and practical material on a single discipline per semester, carried out as a control measure. Student is considered to be admitted to the semester exam on the discipline, if he has visited all provided by the curriculum on the discipline lecture classes, fulfilled all kinds of works, provided by the working curriculum on this discipline and in its study during the semester got not less than the minimum number of points (72 points).

Semester exam is conducted in writing during the examination session, as scheduled. The form of the exam must be standardized and include control of theoretical and practical training.

The maximum number of points that a student can get in the exam is 80.

The minimum number of points in the exam is at least 50.

Determination of the number of points that a student got from the discipline

Mark of the discipline, culminating in the exam is defined as the sum of points for current educational activity (at least 72) and points for the exam (at least 50).

Mark of the disciplines, which form of the final control is differentiated test is based on the results for current educational activity and is calculated in points, according to the table 1.

Table 1

Recalculation of the average grade for current activities in a multi-point scale for disciplines, ending with an exam

| 4- бальна шкала | 200- бальна шкала | 4- бальна шкала | 200- бальна шкала | 4- бальна шкала | 200- бальна шкала | 4- бальна шкала | 200- бальна шкала |
|-----------------------|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
| 5 | 120 | 4.45 | 107 | 3.91 | 94 | 3.37 | 81 |
| 4.95 | 119 | 4.41 | 106 | 3.87 | 93 | 3.33 | 80 |
| 4.91 | 118 | 4.37 | 105 | 3.83 | 92 | 3.29 | 79 |
| 4.87 | 117 | 4.33 | 104 | 3.79 | 91 | 3.25 | 78 |
| 4.83 | 116 | 4.29 | 103 | 3.74 | 90 | 3.2 | 77 |
| 4.79 | 115 | 4.25 | 102 | 3.7 | 89 | 3.16 | 76 |
| 4.75 | 114 | 4.2 | 101 | 3.66 | 88 | 3.12 | 75 |
| 4.7 | 113 | 4.16 | 100 | 3.62 | 87 | 3.08 | 74 |
| 4.66 | 112 | 4.12 | 99 | 3.58 | 86 | 3.04 | 73 |
| 4.62 | 111 | 4.08 | 98 | 3.54 | 85 | 3 | 72 |
| 4.58 | 110 | 4.04 | 97 | 3.49 | 84 | Менше 3 | Недос- татньо |
| 4.54 | 109 | 3.99 | 96 | 3.45 | 83 | | |
| 4.5 | 108 | 3.95 | 95 | 3.41 | 82 | | |

The number of points for different types of individual independent work of the student (VTS) depends on its volume and significance, but not more than 8 points. These points are added to the sum of points earned by the student for the current academic activity.

Students' independent work is assessed during the current control of the topic in the relevant lesson. Assimilation of topics that are submitted only for independent work is controlled during the final control.

Final control is carried out in order to assess learning outcomes at a certain educational and qualification level and at some of its completed stages on a national scale and ECTS scale. Final control includes semester control and student certification.

Semester control is carried out in the form of credit in the amount of educational material determined by the working program of the discipline and in the terms established by the working curriculum, individual student curriculum.

Semester test is a form of final control, which consists in assessing the student's mastery of educational material solely on the basis of the results of all types of educational work provided by the working curriculum. The semester credit is set based on the results of the current control.

The semester exam is a form of final control of mastering by the student of theoretical and practical material for a semester which is spent as a control action. A student is considered admitted to the semester exam in the discipline if he attended all classes provided by the curriculum in the discipline, performed all types of work provided by the work program of this discipline and during its study during the semester scored at least the minimum (72 points).

The semester exam is conducted in writing during the exam session, according to the schedule. The form of the exam includes control of theoretical and practical training.

The exam consists of the following stages:

Stage I - written answer to test tasks of format A (blank test control).

The student answers the test package. Each package contains 40 A-format tests on the topics of each content module, which are part of the final module.

Stage II - written answer to 4 questions and 2 situational tasks.

The student receives a block of questions - 4, which must be answered in writing, as well as a block of situational problems -2, which must be solved in writing.

Stage III - testing of practical skills. The student demonstrates knowledge and skills of 2 practical skills.

Criteria for evaluation and system of the distribution of examinational points

| Test control | Written control | Demonstration of practical skills | | | | | | |
|--|------------------|-----------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | Question | Case studies | | | | | | |
| | 1 | 2 | 3 | 4 | 1 | 2 | 1 | 2 |
| “5” – 36-40 points (91-100%) of the correct answers for the tests | «5»– 4-5 points | «5»– 4-5 points | «5»- 5 points | «5» – 5 points | «5» - 5 points | «5» - 5 points | «5» - 4-5 points | «5» - 4-5 points |
| “4” – 29-35 points (71-90%) of the correct answers for the tests | «4»– 3-4 points | «4» – 3-5 points | «4» – 3-5 points | «4» – 4-5 points | «4» - 4-5 points | «4» - 4-5 points | «4» - 3-4 points | «4» - 3-4 points |
| “3” – 20-28 points (50-70%) of the correct answers for the tests | «3» – 3-4 points | «3» – 3-4 points | «3» – 3-4 points | «3» – 3-4 points | «3» - 3-4 points | «3» - 3-4 points | «3» - 2-3 points | «3» - 2-3 points |
| “2” – 0 points. Less than 50% of the correct answers for the tests | points 2» – 0 | «2»– 0 points | «2»– 0 points | «2»– 0 points | «2» – 0 points | «2»– 0 points | «2» – 0 points | «2» – 0 points |

The maximum number of points a student can score in an exam is 80. The minimum number of points during the examination - not less than 50.

Determination of the number of points the student got from the discipline: A score from a discipline is defined as the sum of points for the current educational activity (not less than 72) and marks for the exam (not less than 50). Discipline points are independently converted into both the ECTS and 4-point scale. The ECTS scores on the

4-point scale are not converted and vice versa. Students' points, taking into account the number of points scored from the discipline, are ranked on the ECTS scale as follows:

Mark of the disciplines, which form of the final control is test (differentiated test), is based on the results of current educational activity and is expressed by two-point scale "Passed" or "Not passed". To enroll a student must get for current educational activity at least 60% of the maximum amount of points in the discipline (120 points).

Points of the discipline irrespectively are converted regardless both in scale ECTS, and in a 4-point scale. Points of the ECTS scale into 4-point scale are not converted and vice versa.

Points of the students, who study in one specialty, including the number of points gained in the discipline, are ranked on a scale ECTS as follows:

Table 2

| Points ECTS | Statistical index |
|--------------------|--------------------------|
| A The best | 10 % of students |
| B Next | 25 % of students |
| C Next | 30 % of students |
| D Next | 25 % of students |
| E The last | 10 % of students |

Points of the discipline for students who successfully completed the program are converted into traditional 4-point scale by absolute criteria that are presented in the table below:

Table 3

| Points of the discipline | Mark by 4-point scale |
|--|------------------------------|
| From 170 till 200 points | 5 |
| From 140 till 169 points | 4 |
| From 139 points till minimum quantity of points, that a student should get | 3 |
| Lower than minimal quantity of points, that a student should get | 2 |

Points ECTS are not converted in traditional scale as the scale ECTS and four-point scale are independent. Objectivity of students' educational activities evaluation is tested by statistical methods (correlation coefficient between the points ECTS and national scale mark).

The percentage of students is determined by the voters for the students of this course within the corresponding specialty.

The number of points from the discipline, which is accrued to students, is converted into a 4-point scale scale in the following way:

| Mark ECTS | Mark on the traditional 4-point scale |
|------------------|--|
| A | "5" |
| B, C | "4" |
| D, E | "3" |
| FX, F | "2" |

The grade for the discipline FX, F (—2) is given to students who have not enrolled in at least one module of the discipline after completing its study.

FX (—2) is given to students who have scored the minimum number of points for the current academic activity, but have not passed the exam. They have the right to re-take the final module control no more than 2 (two) times according to the schedule approved by the rector

13. Methodical support

SMCS includes: the concept of training; educational and qualification characteristics; educational and professional programs; curricula; working curricula of disciplines SMCS includes: discipline program, working discipline curriculum; tasks for independent work of students; knowledge control system (list of questions for credit, evaluation criteria, regulations for credit in the discipline); list of program issues; list of recommended reading; materials of methodical maintenance (methodical instructions to seminars, etc.); instructions for the use of technical teaching aids.

3. CONTENT OF THE PROGRAM

"Morphology and Physiology of Microorganisms. Infection. Immunity. to microbiology. General and special virology. Bio-protection and bioterrorism "

Semantic module 1. Introduction

Specific objectives

- Analyze the stages of development of microbiology as a fundamental and applied discipline for medicine and the contribution of individual scientists in each from its stages.
- Describe the main groups of original methods of microbiological research.
- Interpret the features of the structure, morphology, physiology of certain groups of microbes.

Topic 1. Subject and tasks of medical microbiology. The importance of medical microbiology in the professional activities of pharmacists and pharmaceutical workers. Methods of microbiological research.

Definition of medical microbiology as a science and its place among biological sciences. General microbiology and applied branches of microbiology - agricultural, veterinary, technical, etc.

Medical microbiology and its sections - bacteriology, virology, mycology, protozoology, sanitary microbiology, immunology.

The task of microbiology in the study of the properties of pathogens of infectious diseases and non-pathogenic microorganisms - participants in the biocenoses of the human body and the environment.

Specific features of microorganisms: unicellular structure, relative simplicity of organization, high intensity of metabolism and speed of reproduction, ability to adapt to various elements of the biosphere and to parasitic existence. Non-cellular forms of parasites.

Regularities of interaction of microorganisms with a macroorganism. Microorganisms as parasites. The system of protection of a macroorganism as a necessary condition for its existence.

Tasks of medical microbiology in the fields of development of methods of microbiological diagnostics, specific prevention and treatment of diseases caused by microorganisms.

Microorganism as an object of study of molecular biology, genetics and genetic engineering. Biotechnological microbial processes and their significance for the production of therapeutic and biologically active drugs.

The importance of medical and general microbiology in the health care system and in the professional activities of pharmacists and employees of the pharmaceutical industry.

Fundamental features of modern medical microbiology and trends in its development.

Topic 2. Stages of development of microbiology. Tasks and prospects for the development of modern microbiology.

The main stages of development of microbiology. Ancient and medieval ideas about the causes of infectious diseases. The idea of a "living contagion" (D. Frakostoro, D. Samoilovich). The emergence and formation of microbiology as a science. Discovery of the world of microorganisms (A. Levenhuk). Proving the role of microorganisms as causes of infectious diseases. Works by P. Henle, L. Pasteur, R. Koch. Discovery of the role of microorganisms in the cycle of substances in the biosphere (S. Vinogradsky). Discovery of viruses (D. Ivanovsky). Development of virology as a science. Discovery of antibiotics and chemotherapeutic drugs. Works by P. Ehrlich, O. Fleming, G. Domagko, Z. Waxman, Z. Ermolieva. The emergence and development of ideas for the prevention of infectious diseases (E. Jenner, L. Pasteur). Formation of immunology as a science. (I. Mechnikov, P. Ehrlich).

The role of domestic scientists in the development of microbiology. Contribution of D. Samoilovich, MM

Terekhovskiy, DJ Ivanovskiy, GN Gabrichevskiy, FO Lesh, MF Gamalia, DK Zabolotny, VK Vysokovych, MM Volkovych, VV Pidvysotskiy, 3. V. Yermolieva, PF Zdrodovskiy, VM Zhdanov, AO Smorodyntsev, MP Chumakov, LO Zilber, SM Minervin, SS Dyachenko, VS Derkach, SG Mosing, VV Smirnov in the development of medical microbiology, virology and immunology.

The main stages of development of immunology. Empirical, including the receipt of E. Jenner anti-smallpox vaccine. Pasteur - the doctrine of the attenuation of microorganisms. Obtaining anti-anthrax and rabies vaccines. Development of the doctrine of cellular (II Mechnikov) and humoral (P. Ehrlich) immunity.

Modern directions of development of immunology:

The role of domestic and foreign scientists in the development of immunology. Nobel laureates in the field of immunology.

Development of the doctrine of immunoprophylaxis. E. Jenner, L. Pasteur, E. Bering, G. Ramon and others. History of development of ideas of antimicrobial therapy. Periods of development of chemotherapy. Works by DL Romanovskiy, P. Ehrlich, G. Domagko.

The current stage of development of microbiology. Molecular-biological and molecular-genetic level of research. Achievements of modern microbiology in the fields of diagnosis, treatment and prevention of diseases caused by microorganisms. Genetic engineering of prokaryotes and its significance for biology and medicine. Tasks and prospects of microbiological science.

Content module 2. Morphology and structure of prokaryotes and eukaryotes. Microscopic method of diagnosis.

Specific goals:

- Choose methods of preparation of bacteriological preparation.
- Draw conclusions from the microscopy of bacteriological preparations using an immersion lens.
- Describe the morphological forms of bacteria.
- Explain the structure of a bacterial cell, permanent and non-permanent elements.
- Explain the relationship between the chemical composition, structure and function of the structural elements of a bacterial cell.
- Interpret the results of microscopic examination of microorganisms.
- Analyze the morphology and structure of spirochetes, actinomycetes, fungi and protozoa.
- Explain the main differences between pro- and eukaryotes.

Topic 3. Organization of a bacteriological laboratory. Production of smear preparations. Simple methods of staining bacteria.

Bacteriological laboratory, its structure and purpose. Organization of the workplace of a doctor - bacteriologist. Preparations for microscopy, methods of their manufacture. Dyes, their properties. Method of manufacturing dye solutions. Simple methods of staining microorganisms.

Topic 4. Microscopic method of diagnosis. Types of microscopes. Methods of microscopy.

Methods of research of morphology of microorganisms (microscopy). Light microscopy using immersion lenses. Dark field, phase contrast, luminescent and other methods of microscopy. Electron microscopy (transmission, scanning).

Methods of microscopy in the diagnosis of infectious diseases.

Topic 5. Complex methods of painting. Gram, Ziel-Nielsen methods.

Complex methods of staining microorganisms. Gram staining technique. Factors that affect the staining of microorganisms by Gram. Properties of gram-positive and gram-negative microorganisms. The practical significance of the Gram staining method. Complex methods of painting: Ozheshko, Ziel-Nielsen, Buri-Gins, Lefler (for flagella), Yone.

Topic 6. Morphology and structure of prokaryotes and eukaryotes.

Morphology of bacteria. Sizes, basic forms, mutual arrangement of cells at division. Functional approach in the study of morphology and ultrastructure. Capsule, microcapsule. The structure of the microbial wall in firmicutes and gracilicutes (gram-positive and gram-negative bacteria). L-shapes and spheroplasts. Periplasmic space and cytoplasmic membrane. Mesosomes. Transport structures of the wall and cytoplasmic membrane. Cytoplasm, its contents. Features of the organization of the nuclear apparatus and ribosomes. Inclusion. Flagella, pili, receptor apparatus of cells. Spores and spore formation in prokaryotes. Bacterial polymorphism. Molecules.

Changes in cell structure during intracellular parasitism. Morphology of rickettsiae and chlamydia. Features of morphology of spirochetes and actinomycetes. Morphology of fungi. Morphology of protozoa. Content module 3. Physiology of microorganisms. Evolution, systematics and nomenclature of microorganisms.

Specific goals:

Describe the most commonly used nutrient media and their preparation, determine their purpose.

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Explain changes in differential diagnostic media during bacterial growth.

Evaluate methods for isolating pure cultures of aerobic and anaerobic bacteria.

Topic 7. Bacterial metabolism. Nutrient media for the cultivation of microorganisms.

Chemical composition of microorganisms. Bacterial proteins, polysaccharides, lipids, their complexes and other macromolecules of microorganisms. Toxic macromolecules of microbial cells. Nucleic acids of microorganisms. Minerals, ionic and buffer systems, trace elements. Comparison of the chemical composition of different microorganisms and eukaryotic cells.

Bacterial nutrition. Holophyte diet. Phototrophic and chemotrophic types of nutrition. Sources of nitrogen and carbon. Hemoorganotrophs (heterotrophs). Auxotrophs. Features of nutrition of parasitic microorganisms. Needs for mineral salts, growth factors. Mechanisms of transport of nutrients and ions into the cell. The value of periplasm enzymes. Permeases.

Energy processes and metabolism in bacteria. Biological oxidation in bacteria. Intensity of energy processes in bacteria. ATP synthesis. Bacterial respiration. Aerobes, obligate anaerobes, facultative anaerobes, microaerophilic and drip microorganisms.

Protein metabolism in bacteria. Sources of amino acids, their synthesis. Genetic control of protein synthesis. Transcription and translation in the transmission of genetic information. Features of protein synthesis systems. Decomposition of proteins, end products of protein metabolism and methods for their determination.

Nucleic acids in bacteria. Precursors of nucleic acids. The principle of matrix synthesis. Genome replication. Nucleic acid polymerase enzymes.

Metabolism of carbohydrates and lipids in bacteria. Ways of decomposition of carbohydrates. Types of fermentation. The final products of carbohydrate metabolism and methods for their determination.

Intensity of metabolic processes in bacteria. Limiting growth factors, the use of microbiological methods for qualitative and quantitative analysis of biologically active substances.

Regulation and self-regulation of biochemical processes in microorganisms.

Nutrient media for the cultivation of microorganisms. Requirements for nutrient media. Classification of nutrient media. Preparation and main components (peptone, agar-agar, gelatin, rolled whey, etc.). Types of nutrient media for the purpose.

Methods of studying the enzymatic activity of bacteria and using them to identify bacteria. Modern methods of accelerated identification of bacteria using automated indicators of enzymatic activity. The use of microbes and their enzymes in biotechnology for the production of amino acids, peptides, organic acids, vitamins, hormones, antibiotics, feed protein, for food and industrial processing, biological wastewater treatment, liquid and gaseous fuels.

Topic 8. Growth and reproduction of microorganisms. Cultural properties of microorganisms. Isolation of pure cultures of bacteria (day II).

Growth and reproduction of microorganisms. Simple division. Fragmentation. Periodic culture. Phases of development of microorganisms in a liquid medium in periodic culture. Methods of culturing microorganisms. Associations of microorganisms and pure cultures.

Isolation of pure cultures of aerobic bacteria. Colonies of microorganisms, features of their formation, properties. Pigments of microorganisms. Continuous cultivation, its importance in biotechnology (production of enzymes, proteins, antibiotics, etc.).

Topic 9. Bacterial enzymes. Isolation of pure aerobic culture day III. Isolation of pure culture of anaerobes.

Bacterial enzymes and their classification. Constitutive and inductive enzymes, genetic regulation. Specificity of enzymes. Exo- and endoenzymes. Limiting habitat factors (temperature, concentration of hydrogen ions, osmotic pressure, oxygen pressure). The concept

of mesophiles, thermophiles, psychrophiles. Halophiles, acid- and alkali-loving bacteria.

Methods of culturing anaerobic bacteria (nutrient media for obligate anaerobes, anaerobic boxes, etc.).

Topic 10. Evolution of microorganisms. Modern systematics, classification and nomenclature of microorganisms.

Modern ideas about the evolution of the microbial world. Fundamental differences in structure and functions between prokaryotes (bacteria), eukaryotes (fungi, protozoa), viruses, viroids, prions. Archaeobacteria and eubacteria.

History of the development of ideas about the taxonomy of microorganisms. Phylogenetic (natural) taxonomy and the use of the genesystem approach.

Numerical systematics. Systematics by D. Bergi.

Classification of prokaryotes, taxonomic groups. Species and its definition in microbiology. Intraspecific categories: subspecies, variants. Taxonomic value of 16 S ribosomal RNA.

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

Content module 4. Sterilization, disinfection, asepsis, antiseptics.

Specific goals:

- To draw conclusions about sterilization methods and modes of operation of sterilizing equipment.
- Choose the method of sterilization depending on the objects.
- Monitor the effectiveness of sterilization and sterility, disinfection.

Topic 11. Microbiological bases of sterilization and disinfection.

The effect of physical, chemical and biological factors on microorganisms. Influence of temperature, concentration of hydrogen ions, osmotic pressure, drying, radiant energy, ultrasound, mechanical and atmospheric pressure. Lyophilic drying of microorganisms, its importance for the preservation of microbial cultures.

Sterilization, definition. Methods, equipment. Autoclaves and hemoclaves. Apparatus for dry heat sterilization. Features of sterilization of solutions for parenteral administration. Methods of sterilization quality control. Chemical and microbiological tests.

Asepsis, its importance in medicine and pharmaceutical practice. Microbiological control over compliance with the rules of asepsis in pharmacies and pharmaceutical production.

Microbiological bases of antiseptics and disinfection. The effect of chemicals on microorganisms. Disinfectants, requirements for them, mechanism of action on the microbial cell. Classification of disinfectants. Sensitivity of microorganisms to disinfectants, mechanisms of resistance, prevention of resistance. Groups of antiseptics for the prevention of Covid-19. Disinfection of premises in the event of a coronavirus infection pandemic Microbiological control of the quality of disinfection and compliance with the rules of asepsis.

Safety precautions when working with disinfectants and sterilization equipment. Mechanism Action of basic groups Antiseptics

Content module 5. Bacterial genetics. Microbiological basis of genetic engineering.

Biotechnology. Identification of pure cultures of microorganisms.

Specific goals:

- Explain the mechanism of operation of the operon.
- Explain the mechanism of different forms of genotypic variability (mutations and recombination).
- Explain the mechanisms and manifestations of modification variability.
- Know and be able to explain the mechanism of genetic methods of diagnosis and identification of bacteria.
- Explain the relationship between genetic structures and bacterial virulence factors.
- Explain the methods of application and tools of genetic elements of microorganisms in genetic and molecular technologies.
- To identify the isolated pure cultures of bacteria according to the results of the study.

Topic 12. Genetics of bacteria. Microbiological basis of genetic engineering. Biotechnology.

Definition of genetics of microorganisms as a science. Its importance in the theory and practice of medicine.

The difference between the genomes of prokaryotic and eukaryotic cells. Evolution of the genome of microorganisms. Organization of bacterial cell genetic material: bacterial chromosome, plasmids, migrating

elements. Chromosome structure. Genes. Principles of bacterial genome functioning. Repair system. Plasmids of bacteria, their properties. Conjugative and nonconjugative, integrative and autonomous plasmids. Classification of plasmids by functional activity: F, R, Co1, H1y, Ent and other plasmids. Integrons and superintegrons.

Transposons, insertion sequences. General characteristics and functions of migrating genetic elements.

The concept of gene pool, genotype and phenotype. 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. Types of mutations: deletions, translocations, inversions, duplications, insertions.

Genetic recombination and its types. Mechanisms of genetic information transfer in bacteria and their significance for obtaining bacterial strains with given properties and for compiling genetic maps. Transformation, transduction and conjugation.

The importance of mutants and recombinants in the existence of a bacterial population. Heterogeneity of the population of microorganisms, types and mechanisms of population variability. Genetic selection. The concept of dissociation of bacteria, S- and R-forms of colonies. The value of variability in the evolution of microorganisms.

Microbiological bases of genetic engineering and biotechnology. The use of enzymes (restrictase, ligase, polymerase, revertase) in genetic engineering studies. Vectors used to transfer genetic material. Features of gene expression in prokaryotic and eukaryotic cells. Practical use of the results of genetic engineering research in medicine, biology and national economy.

Genetic methods in the diagnosis of infectious diseases and in the identification of bacteria: DNA sequence, polymerase chain reaction, nucleic acid hybridization, determination of the length of nucleic acid fragments, etc. Biochips, application in diagnostics.

Importance of biotechnology for pharmaceutical science and industry. basic biotechnological products used in medicine: antibiotics, vitamins, hormones, enzymes, proteins and other macromolecular compounds. Requirements for microorganisms-producers of biologically active substances. The value of genetic engineering to obtain highly productive strains of microorganisms. The use of microbial enzymes (polymerases, restrictases, ligases, revertases) in genetic engineering studies. Vectors of genetic material, methods of their introduction. cultivation conditions and rules of work with genetically modified microorganisms. Environmental protection from genetically modified microorganisms.

Topic 13. Identification of the selected pure culture of microorganisms.

Identification of pure cultures of microorganisms. Type of microorganisms, definition. Properties of microorganisms, which determine their species. Methods for determining the type of microorganisms. The concept of biovars, serovars, phage. Features of cultivation of rickettsiae, chlamydia, spirochetes.

The value of bacteriological (cultural) method in the diagnosis of infectious diseases.

Features of cultivation of microorganisms for technological purposes. Excess synthesis. Accumulation of products of synthesis and intermediate metabolism in cells and the environment, importance in biotechnological processes. Synthesis by microorganisms of amino acids, vitamins, organic acids and other substances. Obtaining microbial enzymes, polysaccharides, proteins.

Modification of organic substances by microorganisms and their use to obtain vitamin, hormonal and other medical drugs.

Features of the physiology of the simplest. Physiology of microscopic fungi. Media for cultivation of mushrooms. Cultivation of mushrooms for technological purposes.

Content module 6. Infection.

Specific goals:

- Interpret the concept of "infectious process".
- Analyze the forms of the infectious process, their characteristics and conditions of occurrence.
- Evaluate bacterial pathogenicity factors.
- Characterize the concept of "pathogenicity", "virulence".
- Analyze the mechanisms of development of the infectious process (pathogenesis).

Topic 14. The role of microorganisms in the infectious process. Virulence factors. Toxins of microorganisms. Experimental method of microbiological diagnostics.

Definition of **infection**, —infectious process, infectious disease. Development of ideas about the essence of the infectious process. Conditions of occurrence of infectious process.

The role of microorganisms in the infectious process. Pathogenicity of microbes, determination. Pathogenicity as a consequence of the evolution of parasitism. Obligatory-pathogenic, conditionally - pathogenic, non-pathogenic microorganisms. Ways of penetration of pathogens into the body. Adhesion of microorganisms, colonization, aggregation, formation of biofilms, invasion.

Virulence, definition, units of measurement. Bacterial pathogenicity factors: adhesins, invasins, pathogenicity enzymes, bacterial structures and substances that inhibit phagocytosis. Microbial toxins, their classification. Protein toxins (exotoxins), properties, mechanism of action. Units of exotoxin strength.

Cell-related toxins (endotoxins). Lipopolysaccharides of the wall of gram-negative bacteria as endotoxins. Mechanism of toxic and pyrogenic action. Endotoxins as a contaminant factor in solutions for parenteral use, methods for detecting and preventing contamination. Toxic properties of microbial enzymes.

Pathogenic properties of rickettsiae, chlamydia, mycoplasmas, fungi and protozoa. Obligatory intracellular parasitism of viruses. Genetic control of pathogenic factors of microorganisms. Heterogeneity of microbial populations on the basis of virulence.

Biological research method. Its use in the study of etiology, pathogenesis, immunogenesis, diagnosis, therapy and prevention of infectious diseases. Laboratory animals, pure genetic lines of animals.

Topic 15. Infectious process. Forms of infection. Types, conditions of origin, development and spread of the infectious process.

Phases of development of the infectious process. Critical doses of microorganisms that cause infectious disease. Distribution of microbes and their toxins in the body: bacteremia, toxemia, sepsis and its consequences. Microbiosystem. Asymptomatic infection. Dynamics of infectious disease - periods of incubation, prodromal, exacerbation, final.

Forms of infection: exogenous and endogenous; focal and generalized; monoinfection and mixed; secondary infection, reinfection, superinfection, relapse; acute, chronic, persistent infection. The concept of wound infections, respiratory, intestinal, venereal and skin infections; anthroponotic, zoonotic, anthrozoonic and saprotonic infections. Mechanisms of transmission of infections: fecal-oral, airborne, sexual, alimentary, transmissible, contact-household, transplacental. Source and reservoir, mechanism and factors of transmission of coronavirus infection. The concept of the pathogenesis of infectious disease. Features of etiopathogenesis of coronavirus infection.

Forms of infection in populations: epidemic, pandemic, endemic, sporadic diseases, epizootic.

Content module 7. Fundamentals of immunology.

Specific goals:

- Explain the role and mechanisms of non-specific anti-infective protection of the human body.
- Interpret the concept of "body's immune system".
- Analyze the forms and types of immune response.
- Interpret the phases of the immune response.
- Draw conclusions about the use of microbial antigens in medical practice.
- Draw conclusions about the use of antibodies in medical practice.

Topic 16. Factors of non-specific protection of the organism. Immunology, stages of development.

The main sections of modern immunology: infectious and non-infectious, clinical, transplantation, environmental; immunogenetics, immunopathology, immunooncology, allergology, cytoimmunology, immunohematology, etc. The role of immunology in the development of medicine and biology, its connection with other sciences. Immunological research methods.

Factors of nonspecific protection of the organism.

Barrier and antimicrobial properties of the skin, mucous membranes. Normal microflora. Reactivity of cells and tissues. Physico-chemical factors, function of excretory organs and systems.

Phagocytosis. The role of Ilya Mechnikov in the development of the doctrine of phagocytosis. Classification of phagocytic cells. The main stages of phagocytosis. Biochemical mechanisms of bacterial damage by phagocytes. Complete and incomplete phagocytosis. Methods of studying phagocytic activity. The importance of phagocytosis in the implementation of natural immunity and in the development of the immune response. The doctrine of Toll receptors of phagocytes.

Killing system of the human body: natural killers, large granular lymphocytes (VGL), K-cells, LAC - cells (leukinactivated killers), their role in immunological surveillance of genetically (pathologically) altered cells of the human body.

Macrophages (migrating and tissue), granulocytes - neutrophils, eosinophils, basophils (migrating and tissue). Humoral factors of nonspecific protection: complement system, lysines, interferons, leukins, antiviral inhibitors, lysozyme, plakin, properdin, fibronectin, etc.

The main components of the complement system. The role of complement in chemotaxis, opsonization and lysis of microbes, the development of allergic and immunopathological processes. Methods qualitative and quantitative determination of complement. Classic and alternative ways of complement activation.

Interferons. Classification of interferons, inducers, mechanism of formation, biological functions of interferons (antiviral, antitumor, immunomodulatory, radioprotective). Recombinant interferons.

Topic 17. Immunity. Central and peripheral organs of the immune system. Immunocompetent cells. Mechanisms of the immune response.

Immunity as a way to protect the body from substances that have signs of genetic alienation and is implemented by a specialized immune system. Formation of the body's immune system.

The structure of the immune system. Central organs of the immune system: thymus, bone marrow. Peripheral organs of the immune system: spleen, lymph nodes and lymphoid clusters associated with the mucous membrane. Immunocompetent cells. T-lymphocytes, their ontogenesis. Subpopulations of T-lymphocytes: Th0, Th1, Th2, their comparative characteristics. Surface markers and receptors of these cells: CD4 + - lymphocytes (helpers), CD8 + - lymphocytes (cytotoxic, effector), their functions. B-lymphocytes, ontogenesis. B-lymphocyte subpopulations. Surface markers and receptors. Cooperation between immunocompetent cells in the process of forming an immune response. The concept of immunomodulators. Immunostimulants and immunosuppressants.

Topic 18. Cellular and humoral immunity. Immune status. Allergy.

Forms and types of immune response. Humoral immune response and its stages: recognition, antigen processing, antigen presentation to T-helpers and B-lymphocytes, proliferation and differentiation of B-lymphocytes. T- and B-dependent antigens, their effect on the immune system, antibody synthesis by plasma cells. Immunological memory, memory cells. Primary and secondary immune response. Interaction of cells of the immune system in the process of immune response. Involvement of macrophages, T- and B-cells. Interleukins.

Cellular immune response and its stages: recognition, antigen processing, antigen presentation to Th lymphocytes, proliferation and differentiation of effector T cells (helpers, suppressors, delayed-type hypersensitivity effectors, memory cells). Cytokines and their role in the formation of cellular immune responses.

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

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

Comprehensive assessment of the immune status of the organism on the indicators of non-specific protective factors, the state of T- and B-systems. The role of assessing the immune status of the organism in the diagnosis of infectious diseases and pathology of the body's immune system.

Immunodeficiency states. Classification of immunodeficiency states at birth and acquired, primary and secondary.

Content module 8. Antigens, antibodies. Immune reactions.

Specific goals:

- Explain the role of antigens as inducers of the immune response.
- Describe the structure of antigens, including antigens of microorganisms.
- Explain the role of antibodies in the immune response.
- Describe the structure of antibodies (different classes of immunoglobulins).
- Analyze the mechanisms of interaction of antibodies with antigens.
- Interpret the involvement of immune system cells in the immune response and the immune response phase.

Topic 19. Antigens, haptens. Microbial cell antigens.

Antigens as inducers of the immune response.

The structure of antigens. Antigenic determinants (epitopes). Classification of antigens. Complete antigens and haptens. Types of antigenic specificity. Adjuvants. Antigenic structure of microorganisms. Localization, chemical composition and specificity of antigens of bacteria, viruses, enzymes, toxins. The role of microbial antigens in the infectious process and the development of the immune response. Human histocompatibility antigens. Erythrocyte antigens of different blood groups, autoantigens, embryonic, tumor and human transplant antigens.

Topic 20. Immunoglobulins, classes, properties, functions. Monoclonal antibodies.

Structure and functions of antibodies (immunoglobulins).

Constant and variable regions of H- and L-polypeptide chains, domains. Structure of active centers of immunoglobulins. Heterogeneity of molecules. The concept of valence of antibodies. Fc - (cellular) receptors. The mechanism of interaction of antibodies with antigens. Classes of immunoglobulins, their structure and properties. Antigenic structure of immunoglobulins: isotype, allotypic, idiotypic determinants. Antiidiotypic antibodies. Pathological immunoglobulins. Genetics of immunoglobulins. Autoantibodies. The concept of polyclonal and monoclonal antibodies. Principles of obtaining monoclonal antibodies. Hybridomas as producers of monoclonal antibodies. Synthesis of antibodies in the body. Plasmocytes: the concept of "plasma cell clone".

Topic 21. Serological reactions. Serological identification, serological diagnosis.

Serological reactions, their varieties, specificity, sensitivity, two-phase nature, reversibility. The mechanism of interaction of antigens and antibodies in serological reactions. The main components of serological reactions. Practical use of serological reactions: antigen identification, diagnostic detection of antibodies. Diagnostic immune sera, classification, production, titration, increase of specificity due to adsorption of antibodies by Castellani. Use for serological identification of antigens.

Serological identification - determination of antigens of microorganisms by its reactions with diagnostic sera (in order to establish the type and serovar of microorganisms). Basic serological reactions for identification and criteria for their accounting. Use of serological reactions for indication of antigens of microorganisms for the purpose of express diagnostics of infectious diseases.

Serological diagnosis of infectious diseases by detecting antibodies to the pathogen in the patient's serum. Diagnostics, obtaining, using them for serological diagnosis of infectious diseases (detection of antibodies in the serum of a sick person). The concept of "antibody titer", "diagnostic titer", "diagnostic increase in antibody titer", "paired sera". The principle of differentiation based on the results of serological reactions of an existing infectious disease from a previous one. Criteria for serological diagnosis: detection of antibodies to the pathogen in the diagnostic titer, detection of diagnostic growth of antibody titer, detection of antibodies to the pathogen belonging to the class IgM.

Monoclonal antibodies, their use. Phenomena of detection and methods of registration of serological reactions. Reactions based on the phenomenon of agglutination: direct and indirect agglutination, inhibition reaction of indirect hemagglutination, reaction of inverse indirect hemagglutination, Coombs reaction - antiglobulin test. Reactions based on the phenomenon of precipitation: ring precipitation, flocculation, gel precipitation. Immune lysis reactions (bacteriolysis, spirochetolysis, hemolysis). Complement binding reaction. Immobilization reaction of microorganisms. Opsono-phagocytic reaction. Neutralization reaction (toxins, rickettsiae). Reactions using labeled antigens and antibodies: immunofluorescence (direct and indirect), enzyme-linked immunosorbent assay, radioimmunoassay. Immune electron microscopy.

Content module 9. Immunobiological drugs.

Specific goals:

- Draw conclusions about the use of microbial antigens in medical practice.
- Explain classical and modern methods of obtaining vaccines.
- To draw conclusions about the use of immunoglobulins in medical practice.
- Explain the principles of hybridoma technologies.
- Explain the principle of obtaining, composition and purpose of immun drugs for the diagnosis of infectious diseases.

Topic 22. Active immunization. Vaccines, types, methods of production.

Drugs for active immunoprophylaxis. Modern classification of vaccines: live, inactivated, chemical, toxoids, subcomponent, genetically engineered, synthetic, anti - idiotypic, DNA - vaccines. Methods of manufacture, evaluation of efficiency and control. Associated vaccines. Adjuvants. Autovaccines, vaccine therapy.

Organization of production of vaccines. Rules for transportation and storage of vaccines. Side effects of vaccines. State control over the quality of vaccines.

Topic 23. Passive immunization and serotherapy. Immunoglobulin preparations, types of production and control methods.

Therapeutic and prophylactic immune sera, principles of their production, control, classification, use.

Units of measurement and dosage of sera. Rules of introduction of serums. Complications during administration (serum sickness, anaphylactic shock).

Topic 24. Immunobiological drugs.

Immunomodulators (lipopolysaccharides - pyrogenal, prodigiosan), drugs from bacteria of the BCG strain. Lysates (bronchovax, rynovak), extracts (biostim, ribomunil, bronchomunal, imudol), yeast polysaccharides. Lymphokines.

Content module 10. Antimicrobial chemotherapy and antibiotic therapy.

Specific goals:

- Analyze the phenomenon of microbial antagonism.
- Explain the mechanism of action of antibiotics on the microbial cell.
- Evaluate methods for determining the sensitivity of microorganisms to antibiotics.
- To conclude about the sensitivity of microorganisms to antibiotics.
- To interpret the mechanisms of resistance of microorganisms to antibiotics.
- Explain the mechanisms of complications of antibiotic therapy.

Topic 25. Antimicrobial chemotherapeutic drugs. Mechanisms of resistance development.

Discovery of sulfonamides. Basic principles of rational chemotherapy. The concept of chemotherapeutic drug, chemotherapeutic index.

Microbial antagonism, its mechanisms. Microbial antagonists are producers of antibiotics. The teachings of I Mechnikov on the physiological role of lactic acid bacteria in the intestine. History of the discovery of the first antibiotics: O. Fleming, Z. Waxman. Antibiotics, definition, biological role in nature. Principles of obtaining antibiotics.

Classification of antibiotics by origin, chemical composition, mechanism and spectrum of antimicrobial action. Natural, semi-synthetic and synthetic antibiotics. The mechanism of action of antibiotics on the microbial cell. Antibiotics are inhibitors of cell wall peptidoglycan synthesis, protein synthesis, nucleic acids, as well as those that disrupt the function of the cytoplasmic membrane of bacteria and fungi. Bactericidal and bacteriostatic action of antibiotics. Units of measurement of antimicrobial activity of antibiotics. Methods for determining the sensitivity of bacteria to antibiotics. The concept of minimum inhibitory concentration. Antibiotic chart.

Complications of antibiotic therapy. Dysbiosis. Antibiotic-resistant, antibiotic-dependent and antibiotic-tolerant strains of bacteria.

Natural and acquired resistance to antibiotics. Genetic and biochemical mechanisms of antibiotic resistance. The role of plasmids and transposons in the formation of drug resistance of bacteria. Ways to prevent the formation of bacterial resistance to antibiotics. Principles of rational antibiotic therapy.

Intercellular communication in bacteria (signaling systems, "sense of quorum") and prospects for the creation of a new generation of antimicrobial drugs based on it.

The value of the discovery of antibiotics (twentieth century) for the etiotropic therapy of bacterial, spirochetic, fungal, protozoal infections.

Content module 11. General virology.

Specific goals:

- Interpret the morphology and ultrastructure of viruses.
- Analyze the features of the interaction of viruses with living systems.
- Evaluate the results of virus replication in living systems.
- Analyze methods of culturing viruses in the laboratory.
- To characterize antiviral chemotherapeutic drugs and the mechanism of their action.

Topic 26. History of the discovery of viruses. Viruses, viroids, prions. Morphology and ultrastructure of viruses. Bacteriophages.

Definition of virology as a science. Virology general, medical, sanitary. Tasks of medical virology. The importance of medical virology in the activities of the doctor. Features of the organization and activity of virological laboratories. Achievements of medical virology in the fight against infectious diseases. Unresolved issues.

Kingdom of viruses. Definition of viruses as special forms of living organization. Discovery of viruses DI Ivanovsky. Principles of structural organization of viruses. Virion and its components. Nucleocapsid, capsid, capsomeres, supercapsids (peplos), peplomers. Simple and complex viruses, types of symmetry of nucleocapsids.

Chemical composition of viruses: nucleic acids, proteins, lipids, polysaccharides. Their features and functions. Virus enzymes, their role, classification.

Reproduction of viruses in the process of their interaction with the cell. The main stages of interaction of viruses with cells in productive infection. Integrative and abortive types of interaction of viruses with the host cell. Persistence of the virus in cells. Virus interference, defective interfering particles. Satellite viruses.

The importance of viruses in the development of genetics. Genetic apparatus of viruses. Differences in the genomes of RNA and DNA-containing viruses. Modification variability of viruses: phenotypic mixing, polyploidy. Types of genotypic variability of viruses.

Mutations of viruses, their classification. Mutations are spontaneous and induced, direct and reverse. Mutagens.

Genetic relationships between viruses. Recombination, transduction. Genetic reactivation. Complementation. Virulence of viruses as a genetic trait. Genetic markers of virulence.

Microbiological aspects of COVID-19.

Population variability of viruses. Heterogeneity of viral populations, its mechanisms and practical significance. Dissociation of viruses during reproduction in the cell. Biological properties of dissociants. Cloning of genetic variants. The role of viruses in the exchange of genetic information in the biosphere.

Morphological types and structure of bacteriophages. Chemical composition. Virulent and moderate phages. Stages of productive type of interaction of bacteriophages with bacterial cells. Lysogeny and phage conversion.

Practical use of bacteriophages in microbiology and medicine to identify bacteria, prevent and treat infectious diseases and to assess microbial contamination of the environment.

Topic 27. Cultivation, indication and identification of viruses.

Methods of culturing viruses in chicken embryos, in the body of laboratory animals.

Indication of viral reproduction by hemagglutination reaction (RGA) and hemadsorption.

Methods of culturing viruses in cells. Classification of cell cultures used in virology, their characteristics. Methods of detection (indication) of viral reproduction by cytopathogenic action, plaque formation under agar and bentonite coating, viral inclusions. Methods of quantitative determination (titration) of viruses. Genetic methods for determining viruses and their nucleic components.

Features of serological reactions used in virology. Method of paired sera. Features of viral diagnostics. Complement binding reaction and its features in virology. Reactions used exclusively in virology - hemagglutination and hemadsorption inhibition reaction, virus neutralization reaction.

Topic 28. Features of antiviral immunity. Interferon. Drugs for specific prevention and treatment of viral infections.

Antiviral immunity. Antiviral chemotherapeutic drugs, their classifications: inhibitors of adsorption, penetration and deproteinization of viruses; reverse transcriptase inhibitors, DNA polymerase inhibitors of

DNA-containing viruses; polymerase inhibitors of RNA and DNA-containing viruses; inhibitors of viral mRNA.

Interferons and their inducers, mechanism of antiviral action.

Content module 12. Special virology.

Specific goals:

- Analyze the biological properties of pathogenic viruses for humans.
- Explain the role of viruses in human pathology.
- To interpret methods of diagnosis of viral infections, to draw conclusions based on research results.
- To characterize antiviral chemotherapeutic drugs and the mechanism of their action.
- Analyze drugs used for specific prevention of viral diseases.

Topic 29. Orthomyxoviruses.

Orthomyxoviruses (family Orthomyxoviridae). General characteristics and classification.

Human influenza viruses. The structure of the virion. Genome features. Cultivation. Sensitivity 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 prevention and treatment.

Topic 30. Paramyxoviruses.

Paramyxoviruses (family Paramyxoviridae). General characteristics and classification. The structure of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors.

Genus of paramyxoviruses (Paramyxovirus). Human parainfluenza viruses (types 1 - 5). Mumps virus. Role in human pathology. Immunity. Specific prevention.

Genus of morbillivirus (Morbillivirus). Measles virus, biological properties Pathogenesis of the disease. Immunity and specific prevention.

Genus of pneumoviruses (Pneumovirus). Human respiratory syncytial virus. Biological properties. Pathogenesis of the disease. Immunity.

Persistence of paramyxoviruses and human pathology.

Laboratory diagnosis of paramyxovirus infections.

Topic 31. Picornaviruses

Picornaviruses (family Picornaviridae). General characteristics and classification of the family. Division into genera.

Genus of enteroviruses (Enterovirus). Classification: polio viruses, Coxsackie, ECHO, enteroviruses 68 - 72nd types. Characteristics of virions. Antigens. Cultivation. Pathogenicity to animals. Sensitivity to physical and chemical factors. The value 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 prevention and therapy. The problem of polio eradication worldwide.

Laboratory diagnosis of enterovirus infections.

Genus of rhinoviruses (Rinovirus). General characteristics. Classification. Pathogenesis of rhinovirus infection. Laboratory diagnostics.

Genus Aphotavirus. Foot-and-mouth disease viruses. Biological properties. Classification. Pathogenesis of infection in humans. Laboratory diagnostics, specific prevention.

Genus of cardiociruses (Cardiocirvirus). General characteristics. Role in human pathology.

Coronaviruses (family Coronaviridae). General characteristics. Role in human pathology. The causative agent of Covid-19. Laboratory diagnostics.

Topic 32. Retroviruses. OX.

Retroviruses (family Retroviridae) General characteristics. Classification. Representatives of the subfamilies Oncovirinae, Lentivirinae. Human immunodeficiency virus (HIV). Morphology and chemical composition. Genome features. Variability, its mechanisms. Types of HIV. Origin and evolution. Cultivation, stages of interaction with sensitive cells. Sensitivity to physical and chemical factors.

Pathogenesis of HIV infection. Target cells in the human body, characteristics of surface receptors. The mechanism of development of immunodeficiency. AIDS-associated pathology (opportunistic infections and

tumors). Laboratory diagnostics. Chain polymerase reaction in the diagnosis of HIV infection and Western blot (immunoblot) - test. Treatment (etiotropic, immunomodulatory, immunosuppressive). Prospects for specific prevention.

Topic 33. Other RNA genomic viruses.

Reoviruses (family Reoviridae) General characteristics. Classification. Role in human pathology. Genus of rotavirus (Rotavirus). Classification, properties. Role in human pathology. Laboratory diagnostics. Arenaviruses (family Arenaviridae). General characteristics and classification. The main representatives that cause the disease in humans: lymphocytic choriomeningitis viruses, Lassa, Hunin, Machupo. Laboratory diagnostics. Problems of specific prevention and therapy. Rhabdoviruses (family Rhabdoviridae). General characteristics and classification. Genus Lyssavirus. Rabies virus. The structure of the virion. Cultivation. Sensitivity to physical and chemical factors. Pathogenicity to humans and animals. Pathogenetic features of the disease. Intracellular inclusions (Babes-Negri bodies). Laboratory diagnostics. Specific prevention. Genus Vesiculovirus. Vesicular stomatitis virus, its role in human pathology, diagnosis. Coronaviruses (family Coronaviridae). General characteristics. Role in human pathology. Pathogens SARS, MERS. Laboratory diagnostics. Caliciviruses (family Caliciviridae). General characteristics. Role in human pathology. Laboratory diagnostics.

Togaviruses (family Togaviridae). Genus of rubivirus (Rubivirus). Rubella virus. Role in human pathology. Laboratory diagnostics. Specific prevention.

Flaviviruses (family Flaviviridae), bunyaviruses (family Bunyaviridae), togaviruses (family Togaviridae, genus *Alfavirus*) General characteristics. Classification. Antigens. Cultivation. Sensitivity to physical and chemical factors. The main representatives of pathogenic human flaviviruses are tick-borne encephalitis viruses, yellow fever, dengue fever, Japanese encephalitis, Omsk and Crimean hemorrhagic fevers. Features of pathogenesis. Natural focus.

Tick-borne encephalitis virus. Biological properties, ecological variants of the pathogen. Distribution in nature. The mechanism of transmission of the pathogen to humans. Pathogenesis and immunogenesis of the disease. The role of domestic scientists in the study of flavivirus infections (LO Zilber, MP Chumakov, AK Shubladze, EN Levkovich, etc.).

Laboratory diagnosis of flavivirus infections. Specific prevention and treatment.

Topic 34. Herpesviruses.

Herpesviruses (family Herpesviridae). General characteristics and classification. The structure of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors.

Herpes viruses pathogenic to humans: α - herpesvirus of ordinary (simple) herpes of the 1st and 2nd types, α - herpesvirus of chickenpox - shingles; β - cytomegalovirus herpesvirus (CMV); γ - Epstein-Barr herpesvirus (EBV) - the causative agent of infectious mononucleosis, human cancer. Human herpes viruses of 6, 7, 8 types. Biological properties. Role in pathology. The mechanism of persistence of herpes viruses. Laboratory diagnosis, specific prevention and treatment of herpes infections.

Topic 35. Adenoviruses.

Adenoviruses (family Adenoviridae). General characteristics and classification. Human adenoviruses. The structure of the virion. Antigens, their localization and specificity. Cultivation. Sensitivity to physical and chemical factors. Hemagglutinating activity. Pathogenesis of diseases. Persistence. Oncogenic serotypes of adenoviruses. Intestinal adenoviruses. Laboratory diagnosis of adenoviral infections. Specific prevention and treatment.

Topic 36. Pathogens of viral hepatitis.

Hepatitis A virus (family Picornaviridae), features. Approaches to specific prevention of hepatitis A. Laboratory diagnosis of hepatitis A.

Hepatitis B virus (family Hepadnaviridae). History of study. The structure of the virion. Antigens: HBs is the surface antigen of Dane particles. Internal antigens: HBc, HBe, them characteristic. Sensitivity to physical and chemical factors. Features of the pathogenesis of the disease. Persistence. Immunity. Microbiological diagnostics, methods of detection and diagnostic value of markers of hepatitis B (antigens, antibodies, nucleic acids). Specific prevention and treatment.

Other pathogens of hepatitis: C, D, E, G, TTV, SENV, their taxonomic position, properties, role in human pathology, methods of laboratory diagnosis.

37. Other DNA genomic viruses (poxviruses, papillomaviruses, polyomaviruses, parvoviruses).

Poxviruses (family Poxviridae). Genus Orthopoxvirus. General characteristics and classification. Viruses of human smallpox, monkeys, cows, smallpox vaccine, ectromelia. The structure of the virion. Antigens. Cultivation. Sensitivity to chemical and physical factors. Hemagglutination, its mechanism. Pathogenetic features of the disease. Laboratory diagnostics. Intracellular inclusions (Guarnier bodies). Specific prevention of smallpox. Global eradication of smallpox. Genus Parapoxvirus. Molluscum contagiosum virus. Pathogenesis of infection. Laboratory diagnostics. Papilloma and polyoma viruses (families Papillomaviridae and Polyomaviridae). General characteristics and classification. Morphology of viruses. Human papilloma and polyoma viruses. Pathogenesis of diseases caused by these viruses. Oncogenicity. Laboratory diagnostics. Parvovirus (family Parvoviridae). General characteristics and classification. The structure of the virion. Antigens. Cultivation. Sensitivity to physical and chemical factors. B19 virus, its importance in human pathology. Adeno-associated viruses, their properties, use in genetic engineering.

Topic 38. Oncogenic viruses. Prions.

History of the development of ideas about the role of viruses in carcinogenesis. Signs of a transformed cell. Mechanisms of transforming action of oncogenic viruses. The concept of "oncogene". Theories of the origin of oncogenes. Viral-genetic theory of tumors by LO Zilber.

Oncogenic DNA-containing viruses from the family of papovaviruses, herpesviruses, etc. General characteristics, participation in viral carcinogenesis in humans.

Oncogenic RNA-containing viruses from the retrovirus family are members of the subfamily Oncovirinae. Morphology, classification. Role in human carcinogenesis. Oncogenic viruses of other taxonomic groups (members of the families Adenoviridae, Poxviridae, Hepadnaviridae, etc.). General characteristics. Endogenous retroviruses.

Prions. Properties. Prion diseases of animals (scrapie, spongiform encephalopathy of cows) and humans (chicken, Creutzfeldt-Jakob disease, etc.). Physico-chemical properties. Mechanism of in vivo replication. Pathogenesis of prion diseases. Methods of postmorbidity and lifelong diagnosis.

Topic 39. Biosafety. Biological properties of microorganisms that can potentially be used as bacteriological weapons. The main representatives. Reasons contributing to the spread of epidemics in wartime. Factors influencing the occurrence and spread of infectious diseases in the military. Characteristics of biological weapons. The concept of antibacterial protection of troops. Insulation restrictive measures. Specific and nonspecific indication of bacterial weapons. Methods of sampling, the order of their transportation in the laboratory, accompanying documentation. Organization of work in field laboratories.

Topic 40. Measures to prevent the consequences of bioterrorist activities.

System of anti-epidemic and preventive measures in the army. Anti-epidemic barriers and their role in preventing the occurrence and spread of infectious diseases. Organization of medical care for infectious patients in the army. Features of the course of artificially induced epidemic process. Anti-epidemic providing troops in the conditions of use of biological weapons by the enemy. Measures to eliminate the consequences of the use of biological weapons.

Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of drugs in the conditions of pharmacy production and pharmaceutical enterprises

Content module 13. Pathogenic prokaryotes and eukaryotes.

Specific goals:

- Interpret the biological properties of bacteria - pathogens of infectious diseases and features of the biology of other prokaryotes (spirochetes, mycoplasmas, chlamydia, rickettsiae).
- Explain the pathogenetic patterns of infectious processes caused by pathogenic prokaryotes and eukaryotes (fungi, protozoa), as well as helminths.
- To determine methods of microbiological diagnostics of infectious diseases.
- To determine methods of etiotropic therapy and prevention of diseases caused by pathogenic prokaryotes and eukaryotes.

Topic 1. Pathogenic cocci.

Evolution of the coccal group of bacteria, their general characteristics.

Genus of staphylococci (Staphylococcus). Classification. Biological properties. Pathogenicity factors. The role

of staphylococci in the development of human pathology. Pathogenesis of the processes caused by them. Role in the development of nosocomial infection. Immunity and its features. Drugs for specific prevention and therapy. Methods of microbiological diagnosis of staphylococcal infections.

Staphylococci as possible contaminants of drugs.

Genus of streptococci (*Streptococcus*). Classification, biological properties. Toxins, enzymes of pathogenicity. Role in human pathology. Pathogenesis of streptococcal diseases. Immunity. Methods of microbiological diagnosis of streptococcal diseases.

Etiological and pathogenetic role of group A streptococci in respiratory infections, erysipelas, sore throat, scarlet fever, acute glomerulonephritis, rheumatism, sepsis, etc.

Streptococcus pneumoniae - pneumococcus, biological properties. Pathogenicity factors. Etiological and pathogenetic role of pneumonia streptococcus in human pathology. Microbiological diagnostics. Pathogenicity to humans and animals. Specific prevention of pneumococcal diseases.

Oral streptococci, their role in caries and other dental diseases.

Genus *Neisseria*. Biological properties. Classification. Evolution of pathogenicity.

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

Gonococci (*Neisseria gonorrhoeae*). Biological properties. Pathogenicity for humans, variability. Acute and chronic gonorrhea. Immunity. Microbiological diagnosis of gonorrhea. Prevention and specific therapy of gonorrhea and blenorrhea.

Topic 2. General characteristics of intestinal infections. *Escherichia coli*.

Classification and general characteristics of members of the family Enterobacteriaceae. Modern views on the evolution of intestinal bacteria. Antigenic structure. Virulence factors and their genetic determinism. Pathogenic and conditionally pathogenic enterobacteria. Distribution and ability to survive in the environment. The genus *Escherichia* (*Escherichia*), their main properties. Physiological role and sanitary-indicative value. Diarrheal *Escherichia coli*. Classification by antigenic structure and division into

categories depending on virulence factors, serological markers and clinical and epidemiological features. Parenteral *Escherichia coli*. Microbiological diagnosis of *Escherichia coli*. *Escherichia coli* as possible contaminants of drugs.

Topic 3. Pathogens of intestinal infections. *Salmonella*, *Shigella*, *Proteus*, *Pseudomonas aeruginosa*, etc.

Genus *Salmonella*. General characteristics of the genus. Classification by antigenic structure (Kaufman - White). Pathogenicity to humans and animals.

Salmonella - the causative agent of generalized infections (typhoid fever and paratyphoid fever). Biological properties. Antigenic structure, pathogenicity factors. Pathogenesis and immunogenesis of diseases. Bacteriocarriers.

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

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

Salmonella as possible contaminants of drugs.

Shigella.

Genus *Shigella* (*Shigella*). Biological properties. Classification. *Shigella* virulence factors. Pathogenesis of shigellosis (dysentery). Immunity. Methods of microbiological diagnostics. Features of Grigoriev-Shiga dysentery. The problem of specific prevention. Specific therapy.

Conditionally pathogenic enterobacteria.

Genus *Proteus*, *Morganella*, *Providencia*, *Klebsiella*, *Yersinia*, *Citrobacter*, *Enterobacter*. Biological properties, significance in pathology, features of microbiological diagnosis of diseases caused by opportunistic enterobacteria.

Gram-negative non-fermenting bacteria.

Pseudomonadaceae (family Pseudomonadaceae). Classification. Ecology. Resistance. *Pseudomonas aeruginosa*. Biological properties. Pathogenicity factors. Role in the occurrence of purulent-inflammatory processes and nosocomial infection. Microbiological diagnostics. Treatment.

Other gram-negative non-fermenting bacteria: acinetobacteria, moraxels.

Pseudomonads as possible contaminants of drugs.

Genus *Campylobacter*. Classification. *Campylobacter* - the causative agent of purulent-inflammatory and acute intestinal diseases. Biological properties, microbiological diagnostics.

Genus of *Helicobacter pylori* (*Helicobacter*). Discovery of *Helicobacter pylori* - the causative agent of human gastroduodenal diseases. Biological properties. Factors of colonization of the gastric mucosa. Urease activity. Pathogenesis of *Helicobacter pylori* infection. Methods of microbiological diagnosis: accelerated (urease and histological tests), bacteriological, polymerase chain reaction, serological diagnosis. Modern methods of treatment of *Helicobacter pylori* infection.

Topic 4. Pathogens of bacterial respiratory infections (diphtheria, pertussis, tuberculosis).

The causative agent of diphtheria (*Corynebacterium diphtheriae*). History of discovery and study. Morphology. Cultural properties. Biovars. Resistance. Pathogenicity factors. Diphtheria toxin. Toxicity as a result of phage conversion. Molecular mechanism of action of diphtheria toxin. Pathogenesis of diphtheria. Antitoxic immunity. Bacteriocarriers. Microbiological diagnosis of diphtheria. Immunological and genetic methods for determining the toxigenicity of the diphtheria pathogen. Differentiation of diphtheria pathogen from other pathogenic and non-pathogenic human corynebacteria, toxigenicity control, specific prevention and treatment of diphtheria.

The causative agent of whooping cough.

Pertussis pathogen, biological properties, epidemiology, pathogenesis, microbiological diagnosis of pertussis. Treatment and prevention of whooping cough. Pertussis vaccines.

Mycobacteria (family Mycobacteriaceae)

Pathogenic, conditionally - pathogenic and saprophytic mycobacteria. Mycobacteria of tuberculosis, species, morphological, tinctorial, cultural and antigenic 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 *Mycobacterium tuberculosis* to chemotherapeutic drugs. Epidemic spread of tuberculosis in modern conditions. The causative agent of leprosy. Antileprose drugs.

Pathogens of mycobacteriosis. Classification, properties. Role in human pathology. Mycobacteriosis as a manifestation of HIV infection.

Topic 5. Pathogens of especially dangerous infections (cholera).

Vibrions (family Vibrionaceae).

Vibrio cholerae. Biovars (classical and El-Tor), their differentiation. The spread of cholera. Morphology. Cultural properties, enzymatic activity. Classification of *Vibrios* by Heiberg. Antigenic structure. Virulence factors. Cholera toxin, mechanism of action, methods of cholera toxin detection. Cholera vibrios that are not agglutinated by O-1 serum, O-139 "Bengal" vibrio. Pathogenesis and immunity in cholera. Methods of microbiological diagnostics. Accelerated diagnosis of the disease and indication of *Vibrio cholerae* in the environment. Specific prevention and treatment of cholera.

Halophilic vibrios are pathogens of toxicoinfections. Biological properties. Pathogenicity to humans. Features of microbiological diagnostics.

Other vibrios as a cause of gastroenteritis, wound infection, inflammatory diseases of the internal organs.

Topic 6. Pathogens of especially dangerous infections (plague).

The causative agent of plague. Biological properties. Virulence factors. Pathogenesis of plague. Methods of microbiological diagnosis of plague. Criteria for identification of the causative agent of plague. Specific prevention and treatment of plague.

Topic 7. Pathogens of especially dangerous infections (anthrax).

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

Topic 8. Pathogens of zoonotic infections (tularemia, brucellosis).

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

Brucellae (family Brucellaceae) Classification. Biological properties. Pathogenicity factors. Types of brucellosis and their pathogenicity to humans and animals. Pathogenesis and immunity in brucellosis. Methods of microbiological diagnostics. Drugs for specific prevention and therapy.

Topic 9. Pathogens of gas anaerobic infection.

Genus *Clostridium* Classification. Ecology, properties. Evolution of clostridia. Resistance to environmental factors. Toxicity. Genetic control of toxin production.

Clostridia are the causative agents of anaerobic wound infection. See. Properties, pathogenicity factors, toxins. Pathogenesis of anaerobic wound infection. Antitoxic immunity. Microbiological diagnostics. Specific treatment and prevention.

Clostridium difficile, a role in human pathology.

Bacteroides. *Prevotella*. *Porphyromonas*. Ecology. Biological properties. Pathogenicity to humans. Immunity. Microbiological diagnostics. Antimicrobial drugs.

Fusobacterium. *Propionibacterium*.

Anaerobic cocci, properties. *Peptococcus*. *Peptostreptococcus*. *Veillonella*. Role in human pathology.

Topic 10. The causative agent of tetanus.

Clostridium tetani. Properties. Pathogenicity factors, toxins. Pathogenesis of the disease. Immunity. Microbiological diagnostics. Specific treatment and prevention of tetanus.

Topic 11. The causative agent of botulism.

Clostridium botulinum. Properties. Pathogenicity factors, botulinum toxins. Pathogenesis of the disease. Immunity. Microbiological diagnostics. Specific treatment and prevention of botulism.

Topic 12. The causative agent of syphilis.

General characteristics of the family (family Spirochaetaceae). Classification.

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

Topic 13. Pathogenic tortuous forms of bacteria.

Genus *Spirillum*. The causative agent of fever from rat bites. Microbiological diagnosis of the disease.

Genus *Campylobacter*. Classification. *Campylobacter* - the causative agent of purulent-inflammatory and acute intestinal diseases. Biological properties, microbiological diagnostics.

Genus of *Helicobacter pylori* (*Helicobacter*). Discovery of *Helicobacter pylori* - the causative agent of human gastroduodenal diseases. Biological properties. Factors of colonization of the gastric mucosa. Urease activity.

Pathogenesis of *Helicobacter pylori* infection. Methods of microbiological diagnosis: accelerated (urease and histological tests), bacteriological, polymerase chain reaction, serological diagnosis. Modern methods of treatment of *Helicobacter pylori* infection.

Topic 14. Pathogens of epidemic and endemic relapsing fever. Lyme disease.

Genus *Borrelia*. The causative agent of epidemic recurrent typhus. Pathogenesis, immunity. Microbiological diagnostics. Specific prevention. Pathogens of endemic tick-borne spirochetosis. Pathogenesis, diagnosis. Lyme disease, pathogens, diagnosis, prevention.

Topic 15. Pathogens of leptospirosis.

Family *Leptospiraceae*. The genus *Leptospira*. Classification. The causative agent of leptospirosis. Properties. Pathogenicity to humans and animals. Pathogenesis of leptospirosis. Immunity. Microbiological diagnostics. Specific prevention.

Topic 16. Pathogenic mycoplasmas.

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

Topic 17. Pathogenic rickettsiae. Pathogens of epidemic and endemic typhus.

Rickettsiae (family *Rickettsiaceae*) General characteristics and classification of rickettsiae. *Rickettsiae* are the causative agents of epidemic typhus and Brill-Zinsser disease, endemic typhus.

Topic 18. Pathogens of tick-borne spotted fever, Ku-fever.

Biological properties. Ecology. Hosts and carriers. Resistance. Antigenic structure. Toxin formation. Pathogenicity to humans. Immunity. Microbiological diagnosis of rickettsiosis. Antimicrobial drugs. Specific prevention.

Topic 19. Chlamydia. Pathogens of ornithosis, trachoma.

Chlamydia (family *Chlamydiaceae*) Classification. Biological properties. Ecology. Resistance. Intracellular parasitism. Antigenic structure. Pathogenicity factors. The causative agent of ornithosis. Pathogenicity to humans and birds. Pathogenesis and immunity. Microbiological diagnostics. Antimicrobial drugs. The causative agent of trachoma. Pathogenicity to humans. Trachomaconjunctivitis of newborns (blenorrhea with inclusions). Urogenital chlamydia. Pathogenesis. Microbiological diagnostics. Principles of prevention and therapy.

Topic 20. Pathogens of actinomycosis.

Actinomycetes (family *Actinomycetaceae*).

Pathogenic actinomycetes. Diagnosis of actinomycosis. Chemotherapeutics and antibiotics acting on actinomycetes.

Topic 21. Pathogens of mycoses.

Pathogenic fungi. Classification. Biological properties. Resistance. Pathogenicity factors, toxins. Sensitivity to antibiotics.

Dermatophytes - pathogens of dermatomycosis (epidermophytia, trichophytia, microsporia, favus). Properties. Pathogenicity to humans. Microbiological diagnostics.

Pathogens of deep mycoses: blastomycosis, histoplasmosis, cryptococcosis. Properties. Pathogenicity to humans. Microbiological diagnostics.

Fungi of the genus *Candida*. Properties. Pathogenicity to humans. Factors that cause candidiasis (dysbiosis, etc.). Microbiological diagnostics. Antimicrobial drugs.

Methods and means for the control of molds in pharmacies and pharmaceutical companies.

The causative agent of penicillinosis. Properties. Pathogenicity to humans.

Pneumocystis carinii. Pneumocystis pneumonia in AIDS patients.

Topic 22. Pathogens of malaria.

Plasmodium malaria. Development cycles. Pathogenesis of malaria, immunity. Microbiological diagnostics. Antimicrobial drugs. Prevention

Topic 23. Pathogens of leishmaniasis, amoebic dysentery, toxoplasmosis, trichomoniasis, giardiasis.

Classification. Biological properties. Ecology.

Toxoplasma, amoebae, Giardia, leishmaniasis, trypanosomes, Trichomonas, balantidia. Properties. Role in pathology. Pathogenesis and microbiological diagnosis of diseases. Principles of treatment. Prevention. Free-living amoebae (acanthamoebae, neogleria), their medical significance.

Content module 14. Fundamentals of clinical microbiology.

Specific goals:

- Interpret the biological properties of pathogenic and opportunistic microorganisms and the patterns of their interaction with the human body and the environment.
- To determine methods of microbiological, virological diagnostics, etiotropic therapy and prevention of opportunistic and nosocomial infections.

Topic 24. Clinical microbiology.

Definition. The value of clinical microbiology in the work of the doctor.

Objects of research. Pathogenic and conditionally pathogenic microorganisms. Heterogeneity and variability of populations.

Opportunistic infections.

Definition. Conditions of origin, features: multiorgan tropism of pathogens, polyetiology, low specificity of clinical manifestations, tendency to generalization.

Prevalence of opportunistic infections. Exogenous opportunistic infections (legionellosis, pseudotuberculosis, listeriosis, seraciosis). Endogenous opportunistic infections, the role of the resident microflora of the organism in their occurrence. Microbiological diagnostics. Criteria for the etiological role of opportunistic pathogens isolated from the pathological focus.

Nosocomial infections (hospital, hospital, nosocomial).

1. Definition. Etiological structure. Hospital strains and ecovars of opportunistic microbes. Conditions that contribute to their emergence and spread in hospitals. Features of diagnostics. Microbiological bases of treatment and prevention. Scientific substantiation of anti-epidemic measures. Covid-19 as a nosocomial infection. Measures are aimed at preventing the occurrence and spread of coronavirus infection. Principles of specific diagnostics of

Content module 15. Ecology of microorganisms. Sanitary microbiology and virology. Microflora of the environment.

Specific goals:

- Interpret the concept of "sanitary-indicative microorganisms" and their role as an indicator in assessing the degree of contamination by pathogenic microorganisms of the environment: water, soil and air.
- Analyze the qualitative and quantitative composition of microbes of water, soil and air and draw conclusions about their safety in the epidemic.
- Interpret sanitary-virological and bacteriological criteria for assessment of water bodies, indoor soil.

□ Interpret sanitary-bacteriological indicators of air assessment of premises, utensils, equipment, washes from the hands of pharmacy staff and pharmaceutical companies.

Topic 25. Microflora of the environment.

Definition. Scientific and social preconditions for the formation of ecological microbiology. Population, biotope, microbiocenosis. The main types of interspecific relationships: neutrality,

symbiosis (commensalism, parasitism, mutualism), competition. Dynamics of ecological connections.

Ecological systems of microorganisms. Free-living and parasitic microbes. Microflora of soil, water and air - atmospheric and closed premises (medical institutions, dwellings, etc.).

Microbiological aspects of environmental protection. Protection of groups of microorganisms involved in the circulation of substances and energy from the damaging effects of man-made factors. Biological and man-made pollution and the role of microbes in biodegradation. Microbial degradation of economic materials, medicines. Problems of biosphere protection.

The importance of sanitary microbiology in the activities of physicians and pharmacists. Tasks and methods of microbiological research. Direct methods of detection of pathogenic microorganisms in the environment and indirect methods of sanitary-microbiological research. Microbial count.

Sanitary-indicative microorganisms (SPM) of soil, water and air. Terms and conditions of survival of pathogenic microbes in the environment.

Sanitary microbiology of water. Methods of sanitary-microbiological research of water. Determination of microbial count. Determination of the number of bacteria - indicators of fecal contamination: coli-index and coli-titer (by the method of membrane filters and fermentation). Varieties of *Escherichia coli* and the question of their sanitary significance. Fecal coliform (PCP) bacteria of the *Escherichia coli* group are indicators of fresh fecal contamination. The role of water in the transmission of infectious diseases.

Sanitary microbiology of soil. Sanitary microbiology of soil in connection with the prevention of infections. Pathogenic microorganisms that are detected in the soil. Microbes for which the soil is a natural habitat. Microbes that get into the soil with human and animal feces. Methods of sanitary-microbiological research of soil. Factors influencing the qualitative and quantitative composition of soil microbes. Microbial count, coli-titer, titer-soil perfringence.

Sanitary microbiology of air. The role of air in the transmission of infectious diseases. Methods for determining the microbial count of air. Factors that affect the microbial composition. Methods of sanitary-bacteriological research of air (sedimentation and aspiration). Assessment of the sanitary condition of indoor premises by general microbial contamination, the presence of SPM (staphylococci, gram-negative bacteria, molds and yeasts).

Sanitary virology.

Subject, tasks, significance of sanitary virology in the activity of a doctor.

The role of water, soil, air in the transmission of viral infections. Viruses that are most commonly found in the environment. Covid-19

Topic 26. The microflora of the human body.

Normal microflora of the human body (eumicrobiocenosis). Indigenous and allochthonous microflora of the human body. Microflora of the skin, respiratory tract, digestive and urogenital systems, its anti-infective, detoxifying, immunizing, metabolic role. Methods of studying the role of normal microflora of the human body. Gnotobiology, the importance of gnotobiological principles in the clinic. Factors that affect the quantitative and qualitative composition of the microflora of the human body. The concept of colonization resistance and its role in infectious pathology. Dysbiosis. Conditions of occurrence. Consequences of development. Methods of diagnosis and treatment. Probiotics, prebiotics - drugs to restore the normal microflora of the human body (bifidumbacterin, lactobacterin, colibacterin, bifikol, multiprobiotics group "Symbiter", biosporin, bactisubtil, etc.). Mechanism of action. Dynamics of normal microflora in human

ontogenesis. Pathogenic role of normal microflora and mechanisms of their acquisition of pathogenic properties.

Content module 16. Phytopathogenic microorganisms.

Specific goals:

- Interpret the signs of microbiological damage to plants.
- Identify methods of microbiological diagnosis of plant diseases, etiotropic therapy and prevention of infections caused by phytopathogenic microorganisms.
- Define methods of microbiological control of medicinal raw materials and finished drugs.
- Analyze the qualitative and quantitative composition of microorganisms of medicinal raw materials, finished drugs and draw conclusions about their safety.

Topic 27. Phytopathogenic microorganisms.

Microorganisms as plant parasites. Methods and ways of infecting plants. Ways of spreading pathogenic microorganisms in plant populations, epiphytes. Pathogenicity factors. Bacteriosis and mycoplasmosis of plants. Phytopathogenic fungi. Phytopathogenic viruses and viroids. Damage by phytopathogenic microorganisms of medicinal plants, influence on the accumulation of biologically active substances.

The main signs of bacterial, fungal and viral infections in plants. Rot, mosaics, necrosis, deformation of organs and fruits of plants.

Microbiological research methods in plant diseases. Accumulation of toxic and biologically active products of microbial origin in plants and fruits. Mycotoxins and mycotoxicosis. Rye horn alkaloids. Microbial spoilage of medicinal plant raw materials. Pathogens of wet and dry root rot. Molds and damage to medicinal raw materials.

Methods and drugs for the control of microbial plant diseases. Prevention of microbial spoilage of medicinal raw materials.

Topic 28. Microflora of pharmacies, herbal medicinal raw materials, finished dosage forms.

Microbiological control of the sanitary condition of premises, air and other objects in pharmacies.

Microbiological control of pharmaceutical companies. Methods of combating bacterial and fungal contamination in pharmacies and pharmaceutical companies.

Microbiological control of medicines in the conditions of sanitary production and pharmaceutical enterprises.

Methods of microbiological research of medicines. Tests of drugs for sterility. Tests of microbiological purity of non-sterile drugs (determination of the total number of viable aerobic mesophilic bacteria and fungi and individual species of microorganisms). Evaluation of non-sterile drugs by microbiological indicators.

14. LIST OF QUESTIONS FOR THE EXAM

Content module 1. Introduction to microbiology.

1. Definition of microbiology as a science. Branches of microbiology. Subject and tasks of medical microbiology. The main features and trends of modern microbiology.
2. The task of microbiology in the study of the properties of pathogens of infectious diseases. The importance of medical and general microbiology in the health care system and in the professional activities of pharmacists and employees of the pharmaceutical industry.
3. Discovery of microorganisms by A. Levenhuk. Stages of development of microbiology. The contribution of L. Pasteur and R. Koch in microbiology.

4. Formation of the main directions of microbiological science. The role of D. Samoilovich, E. Jenner, II Mechnikov, D. Ivanovsky, P. Ehrlich, SM Vinogradsky, E. Bering, G. Ramon, F.O. Lesha, G. Domagka, O. Fleming, DK Zaboltny, L.O. Zilber, VM Zhdanov, MP Chumakov, F. Burnett and other scientists. Development of microbiology in Ukraine.

Content module 2. Morphology and structure of prokaryotes and eukaryotes. Microscopic method of diagnosis.

1. The main differences between prokaryotes and eukaryotes. Forms of bacteria with a defect in the synthesis of the cell wall, protoplasts, spheroplasts. L-forms of bacteria.
2. Morphology and structure of bacteria. The role of individual structures for bacterial activity and in the pathogenesis of infectious diseases. Vegetative forms and spores.
3. Morphology of rickettsiae, spirochetes, chlamydia, mycoplasmas.
4. Morphology and classification of protozoa.
5. Classification and morphology of fungi and actinomycetes.
6. Methods of microscopy. Manufacture of bacteriological drugs. Dyes and dyeing solutions, simple and complex methods of dyeing.
7. Principles of organization, equipment and mode of operation of bacteriological, serological and virological laboratories.
8. Bacterioscopic method of research. Stages.

Content module 3. Physiology of microorganisms. Evolution, systematics and nomenclature of microorganisms.

1. Chemical composition of microorganisms. Comparison of the chemical composition of different groups of microorganisms and eukaryotic cells.
2. Types and mechanisms of nutrition of microorganisms. The value of individual components. Permeases.
3. Cultivation of microorganisms. Nutrient media. Requirements for the environment, their types. Preparation and preparation of nutrient media. Organization of production of nutrient media.
4. Respiration of microorganisms. Aerobic and anaerobic types of respiration. Enzymes and cell structures involved in the process of respiration. Methods of culturing anaerobic bacteria.
5. Enzymes of microorganisms, their role in metabolism. Constitutive and adaptive, exo- and endoenzymes.
6. Growth and reproduction of bacteria. Bacterial cell division, phases of reproduction of bacterial culture in stationary conditions.
7. Bacteriological method of research. Principles and methods of isolation of pure cultures of aerobic bacteria and their identification.
8. Features of cultivation of microorganisms for technological purposes. Synthesis by microorganisms of amino acids, vitamins, enzymes, etc.
9. Origin and evolution of microorganisms. Modern classification of prokaryotes. basic taxa. Systematics and nomenclature of bacteria. Species as the main taxonomic unit.
10. Systematics and nomenclature of bacteria. Basic principles of taxonomy. Classification of bacteria. Characteristics of the species.

Content module 4. Sterilization, disinfection, asepsis, antiseptics.

1. The effect of physical, chemical and biological factors on microorganisms (temperature, pressure, drying, ultrasound, radiant energy).

2. Sterilization, definition. Methods, equipment, drugs. Features of sterilization of solutions for parenteral administration. Methods of sterilization quality control.
3. Asepsis, its importance in medicine and pharmaceutical practice. Microbiological control over compliance with the rules of asepsis in pharmacies and in the pharmaceutical industry.
4. Microbiological basis of antiseptics. Disinfectants, classification, requirements for them, mechanism of action on microbial cells. Microbiological control over the quality of disinfection and compliance with the rules of asepsis.
5. Groups of antiseptics for the prevention of Covid-19. Disinfection of premises during a coronavirus pandemic

Content module 5. Bacterial genetics. Microbiological basis of genetic engineering. Biotechnology. Identification of pure cultures of microorganisms.

1. The structure of the genetic apparatus of bacteria (chromosomes, plasmids, migrating elements).
2. Functional units of the bacterial genome. Structural and regulatory genes, transcription, translation, reduplication of genetic information in bacteria.
3. Genotype and phenotype of bacteria. Types of variability in bacteria (modification, genotypic). Mutations, their types. Genetic recombination in bacteria (transformation, transduction, conjugation). Dissociation of bacteria.
4. Gene pool of bacterial population. Genetic maps of microorganisms. Directions of selection of microorganisms. Obtaining and using strains producing antibiotics, enzymes, hormones, vitamins.
5. Plasmids and other mobile genetic elements, their importance in the formation of pathogenic properties of bacteria - toxigenicity, drug resistance.
6. Genetic methods for diagnosing infectious diseases. Polymerase chain reaction. Restriction analysis.
7. Microbiological basis of genetic engineering (enzymes - restrictases, ligases, polymerases, revertases). Vectors, methods of their introduction. Practical use of genetic engineering methods.
8. Importance of biotechnology for pharmaceutical science and industry (production of antibiotics, vitamins, hormones, proteins and other macromolecular compounds). Cultivation conditions and rules of work with genetically modified microorganisms. Environmental protection from genetically modified microorganisms.
9. Identification of pure cultures of microorganisms.

Content module 6. Infection.

1. Infection. Factors that cause the occurrence of the infectious process. The role of microorganisms in the infectious process. Pathogenicity, virulence, units of measurement, methods of determination. Factors of pathogenicity of microorganisms, their characteristics.
2. Toxins of microbes (exo- and endotoxins). Properties and chemical composition, production, measurement of exotoxin strength. Role in the pathogenesis and immunogenesis of infectious diseases.
3. Phases of development of the infectious process. Mechanisms of infection with pathogenic microorganisms. Bacteremia, toxinemia, sepsis. Periods of infectious disease. Etiopathogenesis of Covid-19.
4. The role of the macroorganism in the infectious process. Immunological reactivity of the child's body. The influence of the environment and social conditions on the emergence and development of the infectious process in humans. Persistence of bacteria and viruses. The concept of relapse, reinfection, superinfection. 5. Source and reservoir, mechanism and factors of transmission of coronavirus infection.

Content module 7. Fundamentals of immunology.

1. The doctrine of immunity. Stages of development of immunology. Types of immunity and forms of its manifestation.

2. Nonspecific factors of protection of an organism against pathogenic microbes. Complement, its properties, ways of activation. Cytokines. Phagocytosis, types of phagocytic cells. Stages of phagocytosis. Complete and incomplete phagocytosis.
3. The body's immune system, its organs. The role of the thymus gland in the immune response. Cells of the immune system, their varieties, the interaction of T-, B-lymphocytes and macrophages. Their role in cellular and humoral immunity.
4. Nonspecific factors of protection of a macroorganism from viral agents, their characteristics. Interferons, mechanism of action, interferonogens.
5. Forms and types of immune response. Humoral immune response and its stages. Primary and secondary immune response. Interaction of cells of the immune system in the process of immune response.
6. Immune response reactions, their characteristics. Cellular immune response.
7. Cell cooperation in the immune response. The role of individual cells of the immune system, their interaction. Interleukins.
8. Immunological tolerance, causes of its occurrence. Immunological memory, its mechanism.
9. Immediate and delayed hypersensitivity. The mechanism of development of these reactions.

Content module 8. Antigens, antibodies. Immune reactions.

1. Antigens, their characteristics. Complete and incomplete antigens. Antigenic structure of bacteria. The practical significance of the doctrine of microbial antigens. Autoantigens.
2. Antibodies, their nature. Place of synthesis, dynamics of antibody production. Autoantibodies.
3. Interaction of antigens with antibodies invitro. Complement binding reaction.
4. Agglutination reactions, precipitation. Lysis reactions. Use of serological reactions to detect antigens and identify microorganisms

Content module 9. Immunobiological drugs.

2. Natural and artificial immunization. Active immunity. Preparations for artificial immunization. Vaccines, types, methods of production; requirements for vaccine strains.
3. Live vaccines, vaccines from killed microbial cells and microbial cell components. Genetically engineered and recombinant vector vaccines. Anatoxins, their importance for mass immunization against some infections. Autovaccines. Vaccine therapy.
4. Organization of production of vaccines. Rules for transportation and storage of vaccines. Side effects of vaccines. State control over the quality of vaccines.
5. Passive immunization and serotherapy. Serum preparations: antimicrobial and antitoxic sera, immunoglobulins. Methods of obtaining, cleaning, standardization of serum preparations. Units of measurement and dosage of sera. Rules of introduction of serums. Complications during administration (serum sickness, anaphylactic shock).
6. Promising vaccines (idiotypic, DNA vaccines, polypeptides, etc.). Principles of specific diagnostics of Covid-19.

Content module 10. Antimicrobial chemotherapy and antibiotic therapy.

1. Chemotherapy and chemotherapeutic drugs. Chemotherapeutic index. The mechanism of antibacterial action of sulfonamides. The role of P. Ehrlich and G. Domagko in the development of the theory of chemotherapy.
2. The phenomenon of microbial antagonism. The role of domestic microbiologists in the development of the doctrine of microbial antagonism. Antibiotics, characteristics, principles of production, units of measurement. Classification by mechanism of action on microorganisms.

3. Drug resistance of microbes, the mechanism of formation of stable forms. Minimum inhibitory (IPC) and minimum bactericidal (MBC) concentrations. Practical meaning. Principles of combating drug resistance of microorganisms. Modern methods for determining sensitivity to antibiotics.

Content module 11. General virology.

1. History of discovery and the main stages of development of virology. The contribution of domestic scientists. Methods of studying viruses, their evaluation.
2. Morphology and ultrastructure of viruses. Types of symmetry of viruses. Chemical composition, functions of components of viruses.
3. Bacteriophage, history of study. Structure, classification of phages by morphology. Methods of qualitative and quantitative determination of bacteriophages. Practical use of bacteriophages.
4. Forms of interaction of bacteriophages with a bacterial cell. Virulent and moderate phages. Characteristics of productive interaction. Lysogeny and phage conversion.
5. Modern views on the nature and origin of viruses. The place of viruses in the living system.
6. Principles of virus classification. The main properties of human and animal viruses.
7. Methods of culturing viruses and their evaluation.
8. The use of cell cultures in virology. Classification of cell cultures. Nutrient media for cell culture.
9. Reactions of viral hemagglutination and hemadsorption. Mechanism, practical significance, use, diagnostic value.
10. Hemagglutination inhibition reaction, its mechanism, production conditions, principles of use, diagnostic value.
11. Types of interaction between viruses and cells. Characteristics of productive interaction, stages.
12. Features of the pathogenesis of viral infections. Acute and persistent viral infections.
13. Methods of virus detection in cell culture and their evaluation. Cytopathogenic action of viruses, its types.
14. Features of serological reactions used in virology. Hemagglutination inhibition reaction, virus neutralization reaction. Serodiagnosis of infectious diseases. Diagnostics.

Content module 12. Special virology.

1. Family of Orthomyxoviruses. History of discovery, biological properties, classification.
2. Methods of laboratory diagnosis of influenza and their evaluation.
3. Antigenic structure and types of antigenic variability of influenza virus. Modern hypotheses that explain the antigenic variability of orthomyxoviruses.
4. Pathogenesis and immunity to influenza. The role of specific and nonspecific mechanisms in influenza immunity.
5. The problem of specific prevention and treatment of influenza. Drugs and their evaluation.
6. 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.
7. Measles virus, biological properties, cultivation. Pathogenesis of infection. Laboratory diagnostics, specific prevention.
8. Mumps virus. Pathogenesis of infection. Laboratory diagnosis, specific prevention of mumps.
9. Family of paramyxoviruses. General characteristics. Respiratory syncytial virus. Biological properties, role in the development of human pathology. Methods for diagnosing diseases caused by MS viruses.

10. Picornavirus family, general characteristics. Antigenic structure. Biological features of Cocksackie viruses, properties. Significance in the development of human pathology.
11. Polio viruses, characteristics, classification. Pathogenesis and immunogenesis of infection. Laboratory diagnostics, specific prevention. The problem of polio eradication worldwide.
12. Genus of enteroviruses, general characteristics, classification. Laboratory diagnosis of enterovirus infections.
13. Genus of rhinoviruses, biological properties. Classification. Role in human pathology. Methods of laboratory diagnosis of infections caused by rhinoviruses.
14. Family of Rhabdoviruses. Rabies virus, biological properties. Pathogenesis of the disease. Laboratory diagnostics. Differentiation of fixed and wild rabies virus. Specific rabies prevention.
15. General characteristics of the ecological group of arboviruses. Tick-borne and Japanese encephalitis viruses. History of the discovery and study of these viruses. Biological properties, methods of laboratory diagnostics, specific prevention.
16. Genus Rubiviruses. Red rash virus. Biological properties. Pathogenesis of the disease, immunity. Laboratory diagnostics, specific prevention.
17. Family of Retroviruses, biological properties. Classification. The mechanism of viral carcinogenesis.
18. Herpesvirus family, biological properties, importance in the development of human pathology. Laboratory diagnosis of diseases. Genetic diagnostic methods.
19. Family of Adenoviruses. Biological properties. Antigenic structure. Cultivation. Pathogenesis and laboratory diagnosis of adenoviral infections. Immunity. Specific prevention.
20. The smallpox virus. Pathogenesis of infection. Methods of diagnosis and specific prevention. Vaccine virus. Elimination of smallpox worldwide.
21. Viral hepatitis, properties and classification of viruses. Pathogenesis. Laboratory diagnostics. Prospects for specific prevention.
22. Human immunodeficiency viruses (HIV). Properties. Role in human pathology. The pathogenesis of AIDS. Methods of laboratory diagnostics (immunological, genetic). Prospects for specific prevention and therapy.
23. Human coronaviruses: SARS-CoV, MERS-CoV, SARS-CoV-2. Biological properties. Role in the development of human pathology. Methods of laboratory diagnosis, treatment and prevention of Covid-19. Vaccine development strategy
24. Prions. Properties. Prion diseases of animals (scrapie, spongiform encephalopathy of cows) and humans (chicken, Creutzfeldt-Jakob disease, etc.). Pathogenesis of prion diseases. Diagnosis.

Content module 13. Pathogenic prokaryotes and eukaryotes.

1. The evolution of cocci, their general characteristics. Staphylococci, biological properties, classification, practical significance.
2. The role of staphylococci in the development of human pathology, the pathogenesis of the processes caused by them. Characteristics of toxins and pathogenic enzymes. Role in the occurrence of nosocomial infection.
3. Methods of microbiological diagnosis of staphylococcal processes and their evaluation. Immunity in staphylococcal diseases. Drugs for specific prevention and therapy, evaluation.
4. Streptococci, biological properties, classification. Toxins, enzymes of pathogenicity.
5. Streptococci pneumoniae, biological properties. Pathogenicity to humans and animals. Microbiological diagnosis of pneumococcal diseases.
6. Streptococci. Role in the development of human pathology. Pathogenesis of streptococcal diseases. Toxins and enzymes of streptococcal aggression. Immunity. Methods of microbiological diagnosis of streptococcal diseases.

7. Meningococci, biological properties, classification. Pathogenesis and microbiological diagnosis of meningococcal diseases and bacteriocarriers. Differentiation of meningococci from gram-negative diplococci of the nasopharynx.
8. Gonococci. Biological properties, pathogenesis and microbiological diagnosis of diseases. Prevention and specific therapy of gonorrhoea and blennorrhoea.
9. Enterobacteria, their evolution. Significance in the development of human pathology. Microbiological diagnosis of choleenteritis. *Escherichia coli*, their properties. Pathogenic serovars of *Escherichia coli*, their differentiation. Microbiological diagnosis of coli-enteritis.
10. Pathogenetic bases of microbiological diagnostics of typhoid fever and paratyphoid A and B. Methods of microbiological diagnostics, their estimation.
11. *Salmonella* - pathogens of typhoid fever and paratyphoid A and B. Biological properties, antigenic structure. Pathogenesis of diseases. Immunity. Specific prevention and therapy.
12. *Salmonella* - pathogens of acute gastroenteritis, their properties. Principles of classification. Pathogenesis of food toxicoinfections of salmonellosis nature. Microbiological diagnostics.
13. Genus *Shigella*, biological properties, classification. Pathogenesis of dysentery.
14. *Shigella*. Role in human pathology. Pathogenesis of dysentery, the role of toxins and pathogenic enzymes. Immunity. Methods of microbiological diagnosis of dysentery, their evaluation.
15. Conditionally pathogenic enterobacteria: *Klebsiella*, *Proteus*, *Yersinia*, *Citrobacter*, *Enterobacter* and others. Biological features and microbiological diagnosis of diseases.
16. *Vibrio cholerae*, biological properties, biovars. Pathogenesis and immunity in cholera. Methods of microbiological diagnosis of cholera and their evaluation. Specific prevention and treatment of cholera. Halophilic vibrios, their medical significance.
17. *Yersinia*. The causative agent of plague, the history of the study, biological properties. The role of domestic scientists in the study of plague. Pathogenesis, immunity, methods of microbiological diagnosis and specific prevention of plague. *Yersinia* - pathogens of pseudotuberculosis and enterocolitis, properties, microbiological diagnosis of yersiniosis.
18. The causative agent of tularemia, biological properties. Pathogenesis, immunity, methods of microbiological diagnosis and specific prevention of tularemia.
19. *Brucella*, species, differentiation. Pathogenesis and immunity in brucellosis. Methods of microbiological diagnosis of brucellosis, their evaluation. Drugs for specific prevention and therapy.
20. *Bordetella pertussis*, their properties. The causative agent of pertussis, morphological, cultural, antigenic properties. Microbiological diagnosis and specific prevention of pertussis.
21. Anthrax bacilli. Biological features, pathogenesis, microbiological diagnosis and specific prevention of anthrax. The role of domestic scientists in obtaining drugs for specific prevention of anthrax.
22. General comparative characteristics of anaerobic bacteria, their importance in the development of human pathology. Features of microbiological diagnosis of diseases caused by anaerobes. Anaerobic non-clostridial bacteria (*Bacteroides*, etc.), their biological properties.
23. *Clostridium tetani*, properties. Toxin formation. Pathogenesis of tetanus in humans. Microbiological diagnostics, specific prevention and therapy, their theoretical substantiation and assessment.
24. *Clostridium botulinum*. Morphological and cultural features, antigenic structure, toxin formation, classification. Pathogenesis, microbiological diagnosis and therapy of botulism.
25. Pathogens of anaerobic wound infection, properties, classification. Pathogenesis and microbiological diagnosis. Methods of specific prevention and treatment of anaerobic wound infection.

26. Corynebacteria, characteristics. Evolution of corynebacteria. Biovars of diphtheria bacilli. Toxin formation, genetic determinants of toxigenicity. Measurement of toxin strength.
27. Stages of development of the doctrine of the causative agent of diphtheria. Theoretical bases of specific diphtheria prevention. Diphtheria drugs
28. Pathogenesis of diphtheria, immunity. Microbiological diagnosis of bacteriocarriers. Differentiation of the causative agent of diphtheria and saprophytic corynebacteria.
29. The causative agent of diphtheria, biological properties. Characteristics of exotoxin. Specific prevention and treatment of diphtheria. Detection of antitoxic immunity.
30. The causative agent of leprosy, biological features.
31. Pathogenic mycobacteria, role in the development of human pathology. Pathogens of tuberculosis, properties. Types of tuberculosis bacteria. Pathogenesis and microbiological diagnosis of tuberculosis.
32. Microbiological diagnosis of tuberculosis. Immunity in tuberculosis. Specific prevention and treatment of tuberculosis.
33. Types of tuberculosis bacteria. Tinctorial and cultural properties. Differentiation of tuberculosis pathogens. Atypical mycobacteria. Significance in the development of human pathology.
34. Pathogens of mycobacteriosis. Biological properties.
35. Gram-negative non-fermenting bacteria. *Pseudomonas aeruginosa* (bacillus of blue-green pus). Significance in human pathology. Microbiological diagnostics.
36. The causative agent of syphilis. Morphological, cultural properties. Pathogenesis and immunity. Microbiological diagnosis and specific therapy of syphilis.
37. *Leptospira*, their characteristics, classification. Pathogenesis, immunity and microbiological diagnosis of leptospirosis. Specific prevention and therapy.
38. *Borrelia*, biological properties. Role in the development of human pathology. Pathogens of epidemic and endemic relapsing fever. Pathogenesis, immunogenesis and microbiological diagnosis of typhoid fever. Specific prevention and treatment of recurrent typhus. The causative agent of Lyme disease. Pathogenesis of the disease, microbiological diagnosis, therapy and prevention.
39. Pathogenic spirals. The causative agent of fever from rat bites. Microbiological diagnosis of the disease.
40. *Campylobacter* - the causative agent of acute intestinal diseases. Biological properties, microbiological diagnostics.
41. *Helicobacter pylori* is the causative agent of human gastroduodenal diseases. Discovery, biological properties, pathogenesis. Methods of microbiological diagnostics. Modern methods of treatment of *Helicobacter pylori* infection.
42. *Rickettsiae*, biological properties. Classification. *Rickettsiae* are pathogens in humans. The causative agent of Ku fever. Pathogenesis of the disease, laboratory diagnosis, specific prevention.
43. Pathogens of typhus, properties. Pathogenesis of the disease, evaluation of methods. Specific prevention, evaluation of drugs. Laboratory diagnostics.
44. *Mycoplasmas*, classification. Biological properties, cultivation methods. Role in the development of human pathology. Microbiological diagnosis of mycoplasmosis.
45. *Chlamydia*, classification, biological properties. Cultivation methods. Role in the development of human pathology. Microbiological diagnosis of chlamydia.
46. Pathogenic fungi and actinomycetes (pathogens of candidiasis, dermatomycosis, actinomycosis, their characteristics). Principles of microbiological diagnosis of mycoses.

47. Pathogenic protozoa, biological properties. Classification. Role in the development of human pathology. Laboratory diagnosis of certain diseases. Drugs for treatment.

48. Modern methods of laboratory diagnosis of infectious diseases (genetic, immunological, electron microscopic, etc.).

Content module 14. Fundamentals of clinical microbiology.

1. Conditionally pathogenic microorganisms, biological properties, etiological role in the development of opportunistic infections. Characteristics of diseases caused by opportunistic pathogens.

2. Nosocomial infection, conditions of its occurrence. Properties of hospital ecovars of microorganisms. Microbiological diagnosis of purulent-inflammatory, burn infections and wound infections caused by hospital strains.

3. Clinical microbiology. Object of research. Subject, tasks, methods. Criteria for the etiological role of opportunistic pathogens isolated from the pathological focus.

4. Covid-19 as a nosocomial infection. Measures are aimed at preventing the occurrence and spread of coronavirus infection. Principles of specific diagnostics of Covid-19.

Content module 15. Ecology of microorganisms. Sanitary microbiology and virology. Microflora of the environment.

1. Ecology of microorganisms. The spread of microbes in nature. The value of the works of SM Vynohradsky.

2. Normal microflora of the human body, its role in physiological processes and the emergence of human pathology. Features of the normal microflora of the nose, skin, mouth, genitourinary tract, intestines. Gnotobiology. Dysbiosis and its causes.

3. Probiotics and prebiotics, their characteristics, mechanism of action.

5. Sanitary microbiology, subject, tasks. The importance of sanitary microbiology in the activities of the doctor.

6. Sanitary-indicative microorganisms, requirements to them, their value for the characteristic of objects of environment.

7. Principles of sanitary-microbiological research of environmental objects, their assessment. Sanitary and bacteriological control of drinking water quality. Requirements of the State standard for drinking water.

8. Water microflora. Factors of water self-purification. Survival of pathogenic microorganisms in water. The role of water in the transmission of infectious diseases.

9. Water as a habitat and storage of microorganisms. Indigenous and allochthonous microflora of open reservoirs. Saprobity. Microorganisms - indicators of the process of self-purification of water.

10. Ecology of microorganisms. Microflora of the environment: air, water, soil. Research methods.

11. Sanitary-indicative microorganisms used in assessing water quality.

12. Methods of sanitary-bacteriological research of water and their estimation.

13. Sanitary-indicative microorganisms used in the assessment of soil contamination. Methods of sanitary-microbiological research of soil.

14. Microflora of air, its characteristics. The role of air in the transmission of infectious diseases.

15. Microbial count and sanitary-indicative microorganisms of indoor air, methods of determination, their evaluation.

16. Sanitary-indicative microorganisms of air, methods of their detection. Criteria for assessing the purity of indoor air.

17. Sanitary virology, subject, tasks, significance of sanitary virology in the activity of a doctor.

18. The role of water, soil, air in the transmission of viral infections. Viruses that are most often found in the environment.
19. Sanitary and virological examination of water. Sampling, concentration methods. Viruses, bacteriophages in drinking and sewage. Detection methods.
20. The role of the air environment in the spread of respiratory viral infections. Methods of air sampling and indication of respiratory viruses.
21. Sanitary and microbiological control of pharmacies and pharmaceutical companies.

Content module 16. Phytopathogenic microorganisms.

1. Microorganisms as pathogens of infectious plant diseases (bacteria, mycoplasmas, fungi, viruses, viroids). Methods and ways of infecting plants. Pathogenicity factors. Methods and drugs for the control of microbial plant diseases.
2. The main signs of bacterial, fungal and viral infections in plants. microbiological methods of research of plant diseases. Mycotoxins and mycotoxicosis. Accumulation of toxic and biologically active products of microbial origin in plants and fruits. Prevention of spoilage of medicinal plant raw materials.
3. Microbiological control of sterile drugs.
4. Microbiological control of non-sterile drugs.
5. Methods for determination of endotoxins in sterile drugs.

15. LIST OF PRACTICAL SKILLS AND TASKS FOR THE EXAM

“Morphology and physiology of microorganisms. Infection. Immunity. General and special virology. Bioprotection and Bioterrorism ”

1. Carry out microscopy of the drug using an immersion lens, make a conclusion about the morphological properties of the studied microorganisms.
2. Prepare a bacterial preparation, stain according to the Gram method, perform microscopy using an immersion lens, make a conclusion about the purity of the studied culture of microorganisms.
3. Describe the cultural properties of colonies of microorganisms that have grown on the surface of IPA. Justify the next course of research for the selection of pure culture.
4. Describe the properties of colonies of microorganisms that grew on Endo medium. Find colonies that are characteristic of E. coli. Explain the essence of the use of differential diagnostic media with carbohydrates.
5. Justify the essence of vaccine prophylaxis. Pick up 2-3 live vaccines, explain the principles of their manufacture and use.
6. Justify the essence of vaccine prophylaxis. Pick up 2-3 inactivated vaccines, explain the principles of their manufacture and use.
7. Explain the essence of antitoxic immunity. Choose drugs to create active antitoxic immunity.
8. Explain the essence of antitoxic immunity. Choose drugs to create passive antitoxic immunity.
9. Evaluate the results of determining the sensitivity of pure culture of microorganisms to antibiotics by disco-diffusion method. Conclude.
10. Select the media used for growing cell cultures. Explain the principles of their manufacture.
11. Carry out microscopy of a preparation made of dental plaque and Gram-stained. Describe the morphological forms and tinctorial properties of microorganisms.
12. Explain the essence of serological identification of microorganisms. Choose drugs that are used for this purpose.

13. Explain the essence of serological diagnosis of infectious diseases. Choose drugs that are used for this purpose.
14. To determine the presence of the virus in cell culture by JRS (using fixed drugs).
15. Investigate a drug made from purulent discharge from the urethra of a patient with acute gonorrhoea. Describe and explain the phenomenon of incomplete phagocytosis.
16. To account for the hemagglutination reaction. Explain the purpose of use.
17. Explain the essence of virological diagnosis of influenza. Take into account the hemagglutination test (RGA), delivered to detect the virus. Make a conclusion about the presence and titer of the virus.
18. Explain the essence of virological diagnosis of influenza. To take into account the hemagglutination inhibition reaction (RGGA), set for the purpose of serological identification of the isolated virus. Make a conclusion about the type of virus.
19. Carry out serological diagnosis of influenza. To account for the inhibition of hemagglutination (RGGA) delivered with paired sera of the patient. Make a reasonable conclusion.
20. Explain the essence of virological diagnosis of polio. To establish the presence of the virus in cell cultures infected with material from the patient, by cytopathogenic action (JRS) and the phenomenon of plaque formation. Conclude.
21. Explain the essence of virological diagnosis of polio. Record the virus neutralization (RN) response for serological identification of the virus isolated from the patient. Make a conclusion about the type of virus.
22. Select drugs that are used for specific prevention and treatment of diphtheria, explain the principles of their use.
23. Explain the essence of enzyme-linked immunosorbent assay. Record ELISA for serological diagnosis of HIV infection, Covid-19.
24. Explain the essence of the polymerase chain reaction

"Special, clinical, ecological and sanitary microbiology. Phytopathogenic microorganisms. Microbiological control of medicines in the conditions of pharmacy production and pharmaceutical enterprises. "

1. Carry out bacterioscopic diagnosis of acute gonorrhoea. Conduct a microscopy of the stained drug from the patient's material and draw a conclusion.
2. Carry out bacterioscopic diagnosis of tuberculosis. Carry out microscopy of a special-stained preparation of the patient's material. Conclude.
3. Carry out bacterioscopic diagnosis of diphtheria. Carry out microscopy of a special-stained preparation of the patient's material. Conclude.
4. Carry out serological diagnosis of typhoid fever and paratyphoid fever. To take into account the reaction of indirect hemagglutination (RNGA), to draw a conclusion.
5. Carry out serological diagnosis of typhoid fever and paratyphoid fever. Take into account the reaction of Vidal, draw a conclusion.
6. Carry out serological diagnosis of syphilis. Take into account the Wasserman reaction (RV), draw a conclusion.
7. Explain the essence of bacteriological diagnosis of typhoid fever and paratyphoid fever. To carry out the account of biochemical and to carry out serological identification of the hemoculture selected from the patient. Conclude.
8. Explain the essence of bacteriological diagnosis of dysentery. To carry out the account of biochemical and to carry out serological identification of the coproculture allocated from the patient. Conclude.

16. Select drugs for antimicrobial therapy in a patient with an inflammatory process caused by *Staphylococcus aureus*.

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World Health Organization <http://www.who.int/en/>

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