

MEDICAL UNIVERSITY – PLOVDIV
FACULTY OF MEDICINE

SYLLABUS IN
MICROBIOLOGY

Approved by the Section Council on 31.01.2020/Proceedings №1

Confirmed by the Faculty Council on 08.07.2020/ Proceedings №5

MICROBIOLOGY

SYLLABUS

Course	Final exam	Academic hour count				Hours by year and semester	
		Total	Lectures	Seminars	Credit	IV	V
Microbiology	V	135	60	75	9.3	2/3	2/2

Course name:

Microbiology

Type of course according to the uniform state requirements: Compulsory

Level of education:

Master /M/

Forms of training: Regular

Year of training: 2nd and 3rd year

Duration of training: 1 year (2 semesters)

Academic hours:

60 hours of lectures, 75 hours of exercises

Technical equipment applied in the training:

- multimedia
- demonstration materials
- lectures
- handbooks

Forms of evaluation: Semester exam

Evaluation criteria:

The final grade is multicomponent and includes the marks from the written final exam and the following components:

- average mark from ongoing control (colloquium, tests)
- mark from the oral final examination
- mark from the practical final exam

If one of the components of the final grade is poor 2, then the final grade is necessarily poor 2.

Score assesment:

For each component participating in the final evaluation, a significance coefficient (from 0 to 1) is determined, and the total sum of the coefficients must always be 1. The overall mark is obtained as the sum of the evaluation marks on a six-point scale from the various components multiplied by the respective coefficients of significance.

Q final grade = K1 Q grade from current control + K2 Q grade from written exam + K3 Q grade from the oral exam

K1 = 0.20; K2 = 0.50; K3 = 0.30

Annual exam: Yes

State exam: No

Lecturers:

Habilitated lecturer from the Department of Microbiology and Immunology
Prof. Mariana Murdjeva, MD, PhD

Department: Microbiology and Immunology

➤ **ANNOTATION**

The main goal of the Microbiology course is to thoroughly introduce medical students to the morphological and biological characteristics of microorganisms, the development patterns of the infectious process, specific and nonspecific immune defense of the body, diagnosis of infectious diseases, prevention and control of infection.

The goal is accordant with:

- the volume and the credit rating of the course (according to the ECTS system), visible from the curriculum, available on the MU – Plovdiv website;
- the qualification characteristics of the specialty;
- the educational degree (master).

The goal is accordant with the place of the microbiology discipline in the specialty of Medicine in its importance and chronology in the curriculum. As a fundamental discipline, it predominantly serves the next stages of training.

➤ **COURSE OBJECTIVES**

- Introduction to the morphology, physiology and pathogenicity factors of microorganisms that play a role in human pathology;
- Studying the patterns of occurrence and course of the infectious process, the pathogenesis of infectious diseases and various forms of infection;
- Studying the mechanisms for the protection of macroorganisms - natural resistance and acquired immunity, as well as the principles of immunoprophylaxis and immunotherapy of infectious diseases;
- Antimicrobial chemotherapy - mastering the mechanisms of action of the main groups and representatives of antimicrobial agents, as well as the development mechanisms of bacterial resistance;
- Principles and basic methods for sterilization and disinfection;
- Mastering the microbiological diagnostics of infectious diseases; the structure and role of the microbiological laboratory for etiological diagnosis of infectious diseases; skills for correct clinical interpretation and analysis of laboratory results;

- Learning the methods for microbiological, immunological and molecular-biological diagnostics of the infectious diseases, as well as the correct interpretation of the obtained results;
- Studying the composition and role of the normal microflora of the human body;
- Studying the external environment's role in the spread of infectious agents and methods and means for microbiological control of the environment.

➤ **RESULTS EXPECTED**

After the microbiology course, medical students should be familiar with the morphological and biological characteristics of the most important microorganisms for human pathology, their pathogenic factors, development patterns of the infectious process, and forms of specific and nonspecific immune defense against the microorganism. They must have mastered the rules for collecting and sending pathological material for microbiological examination, the methods for microbiological examination, the interpretation of the obtained results depending on the clinical syndrome, as well as the diagnosis, prevention, and control of the infection.

LECTURE PROGRAM
II year, IV semester

№	TOPIC	HOURS	DATE
1.	Subject, tasks, historical development, and achievements of microbiology. Introduction to general microbiology.	2	
2.	Morphology and structure of microorganisms.	2	
3.	Physiology of bacteria.	2	
4.	Genetics of microorganisms	2	
5.	Influence of environmental factors on microorganisms.	2	
6.	Chemotherapy and antibiotic therapy of infectious diseases.	2	
7.	The doctrine of infection. Characteristics and forms of the infectious process. The role of the microorganism in the infectious process. Pathogenic factors.	2	
8.	The role of the external environment in the occurrence of the infectious process. Epidemic process. Factors and mechanisms for the transmission of infectious agents in the epidemic process.	2	
9.	Immunity. Natural resistance.	2	
10.	Antigens and antibodies.	2	
11.	Specific humoral immunity. Specific cellular immunity. Immunological tolerance.	2	
12.	Immunopathology. Allergies - definition and forms.	2	
13.	Immunodeficiency conditions and diseases. Autoimmunity. Immunoprophylaxis and immunotherapy.	2	

14.	Antigen-antibody reactions. Mechanisms and practical application of the reactions in the microbiological diagnostics.	2	
15.	Modern immunological and genetic methods in clinical microbiology and immunology	2	

HOURS: 30

**LECTURE PROGRAM
III year, V semester**

№	TOPIC	HOURS	DATE
1.	Cocci - staphylococci, streptococci.	2	
2.	Streptococcus pneumoniae. Mycobacterium tuberculosis. The causative agent of leprosy. Causative agents of mycobacteriosis.	2	
3.	Corynebacteria. Hemophilus. Pertussis bacteria. Neisseria	2	
4.	Anaerobes. Spore-forming - tetanus bacillus, gas gangrene bacilli, botulinum bacillus. Non-spore-forming anaerobes.	2	
5.	Causes of particularly dangerous infections. The causative agent of plague. Vibrio cholerae. Anthrax bacillus. Tularemia bacteria. Legionella. Brucella.	2	
6.	Facultative pathogenic intestinal bacteria - Escherichia coli, Klebsiella, Proteus, and others.	2	
7.	Pathogenic enteric bacteria: Dysenteric bacteria. Salmonella - Salmonella typhi, Salmonella paratyphi A and B, Salmonella, causes of food poisoning.	2	
9.	Mycoplasmas and Rickettsiae. Chlamydia.	2	
10.	Pathogenic fungi - Candida, actinomycetes, aspergillus, cryptococci.	2	

11.	Viruses - nature and properties. Picornaviruses.	2	
12.	Ortomyxoviruses. Paramyxoviruses.	2	
13.	Coronaviruses. SARS-CoV-2. Herpesviruses. Poxviruses.	2	
14.	Hepatitis viruses. AIDS viruses.	2	
15.	Adenoviruses. Togaviruses. Flaviviruses. Bunyaviruses. Rhabdoviruses.	2	

HOURS: 30

PROGRAM FOR PRACTICAL CLASSES
II year, IV semester

№	TOPIC	HOURS	DATE
1.	Structure and equipment of the microbiological laboratory and rules for work in it. Methods for studying the morphology of microorganisms. Types of microscopes. Immersion system microscopy.	3	
2.	Study of the morphology of microorganisms in a colored state. Simple staining methods - Löffler and Pfeiffer.	3	
3.	Complex methods for staining the microorganisms. Gram and Neisser staining.	3	
4.	Complex methods for staining the microorganisms. Ziehl-Neelsen staining (acid-fast bacteria). Möller staining (spores).	3	
5.	Resistance of microorganisms. Sterilization and sterilization methods. Disinfection and disinfectants.	3	
6.	Cultivation of microorganisms. Types of nutrient media. Methods for isolation of microorganisms in pure culture. Types of cultures and colonies.	3	
7.	Biochemical activity of bacteria. Pathogenic factors in bacteria.	3	
8.	Determination of the in vitro susceptibility of bacteria to antibiotics (antibiogram).	3	
9.	Recapitulation of the studied material in practical classes from №1 to №8 included.	3	
10.	SEMINAR on the topic: Morphology, physiology, and genetics of microorganisms. Test №1.	3	
11.	Cellular basis of the immune response. Antigen-antibody reactions. Agglutination reaction. Precipitation reaction. Neutralization reaction (ASLO).	3	
12.	Antigen-antibody reactions. Bacteriolysis, hemolysis, cytolysis. Complement fixation test. Immune reactions with labeled antibodies or antigens: immunofluorescence method (IFA), radioimmunoassay (RIA), enzyme-linked immunosorbent assay (ELISA).	3	

13.	Examination of the allergic condition. Bioproducts - vaccines and sera.	3	
14.	Laboratory diagnosis of diseases caused by viruses and rickettsiae. Test №2 on Infection and Immunity.	3	
15.	Assessment of the students' practical skills, acquired during the semester.	3	

HOURS: 45

PROGRAM FOR PRACTICAL CLASSES
III year, V semester

№	TOPIC	HOURS	DATE
1.	Methods for microbiological diagnosis of infectious diseases. General scheme for microbiological examination.	2	
2.	Microbiological diagnosis of staphylococcal and streptococcal infections. Microbiological examination of pus.	2	
3.	Microbiological diagnosis of tuberculosis and leprosy. Microbiological examination in diseases caused by <i>Streptococcus pneumoniae</i> . Microbiological examination of sputum.	2	
4.	Microbiological diagnosis of diphtheria and pertussis. Microbiological examination of throat swabs.	2	
5.	Microbiological diagnosis of gas gangrene and tetanus. Microbiological examination of wound secretions.	2	
6.	Microbiological examination of CNS materials. Microbiological diagnosis and differential diagnosis of bacterial meningitis (<i>Neisseria meningitidis</i> and <i>Haemophilus influenzae</i>).	2	
7.	Microbiological diagnosis of particularly dangerous infections plague, cholera, and anthrax.	2	

8.	SEMINAR on the topic: Microbiological diagnostics of microorganisms, studied in practical classes from №1 to №7. Test №1.	2	
9.	Microbiological examination of materials from the digestive system (feces). Microbiological diagnosis of bacterial dysentery, E. coli enteritis, salmonellosis. Food poisoning by Staphylococcus aureus, salmonella, clostridia (C. botulinum, C. perfringens). Microbiological examination of gastric mucosa biopsy material (Helicobacter pylori)	2	
10.	Microbiological examination of urine. Microbiological diagnosis of pathogens causing urinary tract infections: opportunistic pathogens (E. coli, Klebsiella-Enterobacter-Serratia, Proteus-Providentia-Morganella, Pseudomonas) and obligatory pathogenic (streptococci, salmonella, leptospira, M. tuberculosis).	2	
11.	Microbiological examination for sexually transmitted infections caused by Nesseria gonorrhoeae, Treponema pallidum, C. albicans, chlamydia, and mycoplasmas.	2	
12.	Microbiological examination of blood - blood culture. Causes of septic conditions: obligatory pathogenic (Salmonella typhi, Brucella, Borrelia) and facultative pathogenic. Problematic microorganisms causing nosocomial and iatrogenic infections (Pseudomonas, Enterococcus, MRSA, C. difficile).	2	
13.	Microbiological diagnosis of diseases caused by viruses and rickettsiae.	2	
14.	Sanitary-microbiological examination of water, air, hospital environment. Sanitary-indicative microorganisms - E. coli, Enterococcus, C. perfringens, staphylococci, streptococci.	2	
15.	Recapitulation of the students' practical skills, acquired during the two semesters with an evaluation mark.	2	

HOURS: 30

LECTURE PROGRAMME

LECTURE №1 - 2 hours

Subject, tasks, historical development, and achievements of microbiology. Introduction to general microbiology.

Introduction. Subject, goals, tasks, historical development, and achievements of microbiology. General microbiology: Taxonomy of microorganisms. Characteristics of the different groups of microorganisms: higher protists (Eucaryotae); lower protists (Procaryotae).

LECTURE №2 - 2 hours

Morphology and structure of microorganisms.

Morphology of microorganisms: size and shape of microorganisms; bacterial cell structure. Methods for studying the morphology and structure of bacteria, fungi, mycoplasmas, and viruses.

LECTURE №3 - 2 hours

Physiology of bacteria.

Chemical composition of bacteria: water, minerals, proteins, carbohydrates, lipids, nucleic acids. The importance of bacteria for the diagnosis, pathogenesis, and therapy of infectious diseases. Bacterial enzymes. Bacterial metabolism: catabolic processes. Types of bacteria according to the mechanism of biological oxidation they cause. Anabolic processes (assimilation). Assimilation products and their importance for the pathogenesis, diagnosis, and therapy of infectious diseases. Bacterial growth and reproduction. Principles for in vitro cultivation and nutritional requirements of bacteria. Prototrophs, auxotrophs.

LECTURE №4 - 2 hours

Genetics of microorganisms.

Genotype and phenotype in viruses, phages, and bacteria. Bacterial genome - chemical composition, structure and functions. Plasmids (extrachromosomal elements). Types of plasmids and their significance. Bacteriophages - structure, moderate phage, lytic phages, significance. Heredity and variability in microorganisms - definition of the concepts of heredity and variability in microorganisms. Significance of recombinative variability for biology and medical practice. Genetic engineering - importance for theory and medical practice. Molecular biological methods (PCR, DNA probes) in the diagnosis of infections.

LECTURE №5 - 2 hours

Influence of environmental factors on microorganisms.

Microflora of the human body. The role in normal physiological processes, the body's defenses and pathology. Spread of microbes in the soil, water, food, hospitals, tools, objects in the environment. Influence of physical factors on microorganisms - heat, drying, pH, osmotic pressure, light, ultrasound, ionizing radiation. Sterilization. Sterilization methods. Influence of the chemical factors on microorganisms. Mechanism of action. Oligodynamia. Disinfection. Types of disinfectants. Influence of biological factors on microorganisms - symbiosis, synergism, antagonism, bacteriocins, bacteriophages.

LECTURE №6 - 2 hours

Chemotherapy and antibiotic therapy of infectious diseases.

Chemotherapy. Antibiotics. Types of antimicrobials. Classification of antibiotics according to the origin, spectrum of action, chemical composition. Antibiotic products from the different groups by chemical composition, mechanism of action. Basic requirements for the use of

chemotherapeutics and antibiotics. Mechanisms for acquiring resistance of microorganisms to antibiotics. Fight against drug resistance. Side effects during antibiotic treatment. Determination of the susceptibility of microorganisms to antibiotics. Antibiogram.

LECTURE №7– 2 hours

The doctrine of infection. Characteristics and forms of the infectious process. The role of the microorganism in the infectious process. Pathogenic factors.

Relationships between macro- and microorganisms - mutualism, commensalism, parasitism, saprophytism. Infection, infectious process, infectious disease - definitions. The role of the microorganism in the infectious process: pathogenicity, virulence - infectious doses, contagiousness, invasiveness, toxigenicity. Pathogenicity factors: invasion factors - types, mechanism of action; factors of aggression - endo- and exotoxins. Mechanism of action.

LECTURE №8 - 2 hours

The role of the external environment for the occurrence of the infectious process. Epidemic process. Factors and mechanisms for the transmission of infectious agents in the epidemic process.

Pathogenesis of the infectious process – portal of entry of microbial agents, spread, localization, and damage of the macroorganism. Forms of the infectious process: exogenous and endogenous infection. Primary, recurrent (reinfection), secondary infection; superinfection, coinfection; local and generalized infection; focal infection; septicemia, bacteremia, viremia, toxemia, pyemia. Types of septicemia - transient, obligate; sepsis, septic shock, systemic inflammatory response syndrome (SIRS). The role of the macroorganism in the infectious process. The role of the external environment for the occurrence and course of the infectious process. Epidemic process - factors and mechanisms. Conditions for the occurrence of an epidemic process: the source of infection, mechanism of transmission, and susceptible individuals.

LECTURE № 9 - 2 hours

Immunity. Natural resistance.

The organism's forms of protection - natural resistance, acquired immunity. Protective role of skin and mucous membranes, secretions, normal microflora. Cellular factors of natural resistance. Phagocytosis. Humoral factors of natural resistance: complement, interferons, lysozyme, cytokines, acute-phase proteins. Inflammation.

LECTURE №10 - 2 hours

Antigens and antibodies.

Antigens: characteristics of antigens; antigenic determinants (epitopes), the valence of antigens, haptens; types of antigens; types of antigens in microorganisms. Structure of antibodies. Classes of immunoglobulins and their function.

LECTURE №11 - 2 hours

Specific humoral immunity. Specific cellular immunity. Immunological tolerance.

Immune system: anatomy and structure - central and peripheral organs. Immunocompetent cells - T and B lymphocytes. CD - subpopulations, origin, and significance for the immune response. Cellular immunity - forms. Humoral immunity. Onset and development of the immune response; cell cooperation. Primary and secondary immune response. Genetic control and regulation of the immune response. HLA system. Immunological tolerance - mechanisms.

LECTURE №12 - 2 hours

Immunopathology. Allergies - definition and forms.

Allergic reactions. Types of allergens. Types of allergic reactions according to the Coombs and Gell classification: Type I anaphylactic and atopic allergic reactions from the release of biologically active substances - impairment and clinical manifestations; Type II (cytotoxic); Type III (from Ag-Ab complexes); Type IV (slow type). Autoimmune reactions. Definition. Kinds. Mechanism of occurrence.

LECTURE №13 - 2 hours

Immunodeficiency conditions and diseases. Autoimmunity.

Congenital and acquired immunodeficiency conditions and diseases due to defects of cellular immunity; humoral immunity; phagocytosis; the complement reaction; combined immune deficiency. Clinical manifestations. Laboratory diagnostics. Immune status.

LECTURE №14 - 2 hours

Immunoprophylaxis and immunotherapy.

Immunoprophylaxis: types of vaccines; types of serums. Immunotherapy

LECTURE №15 - 2 hours

Antigen-antibody reactions. Mechanisms and practical application of reactions in microbiological diagnostics. Modern immunological and genetic methods in clinical microbiology and immunology.

Types of immune reactions: agglutination, precipitation, neutralization, complement fixation test. Immune reactions with labeled antibodies or antigens - ELISA, RIA, IFA; immunoblot. Molecular genetic methods - DNA probes, PCR. Importance of immune and genetic reactions for the diagnosis of infectious diseases.

LECTURE №16 - 2 hours

Cocci - staphylococci, streptococci.

Fam. Micrococcaceae. Genus Staphylococcus: *S. aureus*. Genus Streptococcus: *S. pyogenes*.

LECTURE №17 - 2 hours

Streptococcus pneumoniae. Tuberculosis bacteria. Cause of leprosy. Causes of mycobacteriosis.

Genus Streptococcus: *S. pneumoniae*. Fam. Mycobacteriaceae. Genus Mycobacterium: *M. tuberculosis*, *M. leprae*.

LECTURE №18 - 2 hours

Corynebacteria. Haemophilus. Pertussis bacteria. Neisseriae.

Genus Corynebacterium: *C. diphtheriae*. Genus Haemophilus: *H. influenzae*. Genus Neisseria: *N. meningitidis*, *N. gonorrhoeae*. Genus Bordetella.

LECTURE №19 - 2 hours

Anaerobes. Spore-forming - tetanus bacillus, gas gangrene bacilli, botulinum bacillus. Non-spore-forming anaerobes.

Fam. Bacillaceae. Genus Clostridium: *C. tetani*, *C. perfringens*, *C. novyi*, *C. difficile*, *C. septicum*, *C. histolyticum*, *C. botulinum*. Fam. Bacteroidaceae: Genus Bacteroides. Genus Fusobacterium. Genus Leptotrichia.

LECTURE №20 - 2 hours

Causes of particularly dangerous infections. Plague bacteria. Vibrio cholerae. Anthrax bacillus. Tularemia bacteria. Legionella. Brucella.

Genus Yersinia: *Y. pestis*, *Y. enterocolitica*. Fam. Vibrionaceae. Genus Vibrio: *V. cholerae* biotype cholerae, *V. cholerae* biotype eltor. Genus Bacillus: *B. anthracis*. Genus Francisella: *F. tularensis*. Genus Legionella: *L. pneumophila*. Genus Brucella.

LECTURE №21 - 2 hours

Facultative pathogenic enteric bacteria - Escherichia coli, Klebsiella, Proteus and others.

Fam. Enterobacteriaceae. Genus Escherichia: *E. coli*. Tribus Klebsiellae: *Klebsiella-Enterobacter-Serratia*. Tribus Proteae: *Proteus-Providentia-Morganella*.

LECTURE №22 - 2 hours

Pathogenic enteric bacteria: Dysenteric bacteria. Salmonella - Salmonella typhi, Salmonella paratyphi A and B, Salmonella, causes of food poisoning.

Genus Shigella. Rod. Salmonella: *S. typhi*, *S. paratyphi* A, B, C. Salmonella causing food poisoning.

LECTURE №23 - 2 hours

Spirochetes. The causative agent of syphilis. The causative agent of relapsing fever. The causative agent of Lyme disease. Leptospira. Spirilli.

Division: Spirochaetales. Genus Treponema - species, *T. pallidum*. Genus Borrelia: *B. recurrentis*, *B. burgdorferi*. Genus Leptospira - species. *L. icterohaemorrhagiae*, *L. grippotyphosa*, *L. pomona*, *L. nikolaevo* and others.

LECTURE №24 - 2 hours

Mycoplasmas and Rickettsiae. Chlamydia.

Fam. Mycoplasmataceae. Genus Mycoplasma: *M. pneumoniae*, *M. hominis*, *M. oralis*, *M. salivarius*, *M. fermentans*. Fam. Rickettsiaceae. *R. prowazekii*. *Coxiella burnetii*. Fam. Chlamydiaceae. Genus Chlamydia: *C. trachomatis*

LECTURE №25 - 2 hours

Pathogenic fungi - Candida, actinomycetes, aspergillus, cryptococci.

Genus Candida: *C. albicans*. Genus Actinomyces: *A. bovis*, *A. israelii*. Genus Aspergillus, Cryptococcus.

LECTURE №26 - 2 hours

Viruses - nature and properties. Picornaviruses.

History of virology. General characteristics of viruses. Viral taxonomy. Morphology and structure of viruses: DNA / RNA genome, capsid, supercapsid; biology of viruses: viral reproduction, cultivation methods. Epidemiology and pathogenesis of viral diseases; immunity, specific prophylaxis, therapy. Laboratory diagnosis. Characteristics of the picornavirus family. Genus Enterovirus: Human polioviruses 1, 2, 3. Human coxsackieviruses A, B. Human echoviruses. Human enteroviruses 68 - 71.

LECTURE №27 - 2 hours

Orthomyxoviruses. Paramyxoviruses.

Fam. Orthomyxovirinae. Genus Influenzae virus - the cause of influenza. Fam. Paramyxovirinae. Genus: Paramyxovirus, Morbillivirus, Pneumovirus. Cause of bird flu - general characteristics. *V. parainfluenzae*, *V. parotitidis*, *V. morbillorum*, RS viruses.

LECTURE №28 - 2 hours

Coronaviruses. SARS-CoV-2. Herpesviruses. Poxviruses.

Fam. Coronaviridae. SARS-CoV, MERS-CoV, SARS-CoV-2. Fam. Herpesviridae. Subfamily Alpha herpes virinae: Herpes simplex virus 1, 2; Human herpesvirus - 3, Varicella zoster virus (*V. varicellae*, *V. herpes zoster*). Subfamily Beta herpes virinae: Human herpesvirus 5 (Human cytomegalovirus). Subfamily: Gamma herpes virinae: Human herpesvirus 4 (Epstein-Barr herpes virus). Fam. Poxviridae: Orthopoxvirus variolae.

LECTURE №29 - 2 hours

Hepatitis viruses. AIDS viruses.

Hepatitis viruses: Causative agents of viral hepatitis - HAV, HBV, HDV, HCV, HEV. Hepatitis viruses with fecal-oral transmission mechanism - hepatitis A and E viruses. Hepatitis viruses with multiple transmission mechanisms - hepatitis B, D, and C viruses. Characteristics of the virus, the clinical presentation of the disease, laboratory diagnosis (hepatitis markers), specific prevention, and therapy. Fam. Retroviridae. Subfamily Lentivirinae: AIDS viruses (HIV-1 and HIV-2). Acquired Immune Deficiency Syndrome (AIDS): historical data; structure and reproductive cycle of HIV; epidemiology of AIDS; Clinical presentation; laboratory diagnosis; therapeutic approach; prevention.

LECTURE №30 - 2 hours

Adenoviruses. Togaviruses. Flaviviruses. Bunyaviruses. Rhabdoviruses.

Fam. Adenoviridae. Fam. Togaviridae - Rubella virus and others. Fam. Flaviviridae - yellow fever virus and others. Fam. Bunyaviridae – Crimean-Congo hemorrhagic fever virus and others. Fam. Rhabdoviridae - rabies virus.

PRACTICAL CLASSES - THESES

PRACTICAL CLASS №1 - 3 hours

Structure and equipment of the microbiological laboratory and work rules. Methods for studying the morphology of microorganisms. Types of microscopes. Immersion system microscopy.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the specifics of microbiological work and basic microbiological materials. Mastering the technique of preparing wet mount microscope slides.

DEMONSTRATION OF: Structure of a microbiological laboratory and safety rules when working with infectious material. Microbiological equipment, tools, and glassware. Basic microbiological manipulations and requirements when working with infectious material. Preparation of wet mount microscope slide.

PRACTICAL TASKS: Microscopy with immersion system of ready-made colored slides.

PRACTICAL CLASS №2 - 3 hours

Study of the morphology of microorganisms in a colored state. Simple coloring methods - Löffler and Pfeiffer.

PURPOSE OF THE PRACTICAL CLASS: Mastering the technique of preparation of a microscopic preparation and staining by the methods of Löffler and Pfeiffer.

PRACTICAL TASKS: Preparation and staining by the Löffler method of a slide with microorganisms, cultured in a solid nutrient medium. Preparation and staining by the Pfeiffer method of a slide with microorganisms, cultured in a liquid nutrient medium. Diagnostic application of simple staining methods - microscopy of gonococci in a slide with a urethral smear, stained by Löffler. Microscopy of *Helicobacter pylori* in a smear of biopsy material from the gastric mucosa, stained by Pfeiffer.

PRACTICAL CLASS №3 - 3 hours

Complex methods for staining microorganisms. Gram and Neisser staining.

PURPOSE OF THE PRACTICAL CLASS: Mastering the technique of preparation of a microscope slide and staining according to Gram and Neisser.

PRACTICAL TASKS: Gram staining and observation of a microscope slide with a mixed culture of Gram / + / and Gram / - / microorganisms. Staining by the Neisser method (for metachromatic bodies) of a slide with pseudodiphtheria bacteria and observation of a ready-made microscope slide with diphtheria bacteria stained by the Neisser method. Recognition of a ready-made microscope slide with diphtheria bacteria.

PRACTICAL CLASS №4 - 3 hours

Complex methods for staining microorganisms. Ziehl-Neelsen staining (acid-fast bacteria). Möeller staining (spores).

PURPOSE OF THE PRACTICAL CLASS: Mastering the technique of preparation of a microscope slide and staining by the methods of Ziehl-Neelsen and Möeller.

PRACTICAL TASKS: Preparation of a microscope smear of sputum and staining by the method of Ziehl-Neelsen. Preparation of a microscopic slide with spore-bearing bacteria (bacilli) and staining by the method of Moeller. Microscopy of a ready-made microscope slide with spore-bearing bacteria with central non-deformable spores. Detection of tuberculosis bacteria in a sputum slide stained by Ziehl-Neelsen.

PRACTICAL CLASS №5 - 3 hours

Resistance to microorganisms. Sterilization and sterilization methods. Disinfection and disinfectants.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the devices and methods for sterilization and disinfectants.

DEMONSTRATION OF: The sterilization rooms in the department, Koch's apparatus, autoclave, and dry sterilizer. Materials and laboratory vessels and utensils to be sterilized. Method of packaging the laboratory utensils. Disinfectant solutions. Means for control of sterilization and disinfection.

PRACTICAL CLASS №6 - 3 hours

Cultivation of microorganisms. Types of growth media. Methods for isolation of microorganisms in pure culture. Types of microbial cultures and colonies.

PURPOSE OF THE PRACTICAL CLASS: To introduce students to the types of growth media and ways of their preparation. To master the streaking technique and methods for isolating microorganisms in pure culture. To be able to characterize the bacterial growth on solid and liquid culture media.

DEMONSTRATION OF: Different types of ready-made solid and liquid sterile growth media. Cultures of various microorganisms on liquid and solid growth media - ordinary broth, glucose broth, ordinary agar, Levin agar, apocholate-citrate agar, blood agar, and others. Different types of colonies. Streaking technique on Petri dishes with ordinary agar. Inoculation on agar slant. Preparation of inoculum in a deep agar.

PRACTICAL TASKS: Streaking *S. epidermidis* on ordinary agar. Inoculating an agar slant from a colony of *S. epidermidis*. Inoculating a liquid nutrient medium with pathological material (pus).

PRACTICAL CLASS №7 - 3 hours

Biochemical activity of bacteria. Pathogenicity factors in bacteria.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the methods for biochemical characterization and identification of microorganisms. Introduction to the pathogenic factors of bacteria and laboratory methods for their determination.

DEMONSTRATION OF: Tests for saccharolytic activity: decomposition of sugars with and without gas formation; the degree of acidity with methyl-red reagent; Foges-Proskauer test. Tests for proteolytic activity: formation of indole in tryptophan broth; hydrogen sulfide formation; urease activity, etc. Deamination and decarboxylation of the amino acids arginine, lysine, ornithine. Oxidase and catalase activity. Alpha- and beta- hemolysis of blood agar. Plasma coagulase test. Plasma agglutination (clumping-test). Microscopy of encapsulated bacteria (pneumococci and anthrax bacilli) stained by Klett.

PRACTICAL TASKS: Description of the streak plate method prepared by the students in the previous exercise. Testing for indole with Ehrlich reagent. Degree of acidity of bacterial culture with a methyl-red reagent. Inoculating Kligler slant medium. Reporting the results from ready-made biochemical tests on *Escherichia coli* and *Klebsiella pneumoniae*. Plasma agglutination.

PRACTICAL CLASS №8 - 3 hours

Determination of the in vitro susceptibility of bacteria to antibiotics (antibiogram).

PURPOSE OF THE PRACTICAL CLASS: To master the technique of making antibiograms and the principles of their reading and interpretation.

DEMONSTRATION OF: Preparation and interpretation of an antibiogram.

PRACTICAL TASKS: Preparation of an antibiogram. Reading and interpretation of ready-made antibiograms from different types of microbes.

PRACTICAL CLASS №9 - 3 hours

Recapitulation of the studied material from practical classes from №1 to №8 included.

PURPOSE OF THE PRACTICAL CLASS: To establish knowledge and practical skills in microbiology.

PRACTICAL CLASS №10 - 3 hours

SEMINAR on the topic: Morphology, physiology, and genetics of microorganisms. Test №1.

PURPOSE OF THE PRACTICAL CLASS: To consolidate the theoretical knowledge of the studied material. To check the knowledge gained from the independent preparation of students on topics 1-8 of the syllabus.

PRACTICAL CLASS №11 - 3 hours

Cellular basis of the immune response. Antigen-antibody reactions. Agglutination reaction. Precipitation reaction. Neutralization reaction (ASLO).

PURPOSE OF THE PRACTICAL CLASS: Introduction to the morphology of the cells involved in the immune response. Mastering the technique for performing immune diagnostic reactions - agglutination and precipitation, their diagnostic significance, and interpretation.

DEMONSTRATION OF: Microscopic preparations of lymphocytes, leukocytes, blast, and plasma cells. Types of agglutination reactions - Gruber type and Widal type. Types of precipitation reactions - Ascoli ring test, Mancini test, immunodiffusion in agar. ASLO (AST).

PRACTICAL TASKS: Observation and drawing of cells involved in the immune response. Performing Gruber agglutination test, Ascoli ring test. Interpretation of AST titers.

PRACTICAL CLASS №12 - 3 hours

Antigen-antibody reactions. Bacteriolysis, hemolysis, cytolysis. Complement fixation test (CFT). Immune reactions with labeled antibodies or antigens: immunofluorescence method (IFA), radioimmunoassay (RIA), enzyme-linked immunosorbent assay (ELISA).

PURPOSE OF THE PRACTICAL CLASS: Introduction to the technique of immune reactions CFT and the principles of marked immune reactions, their interpretation, and diagnostic value.

DEMONSTRATION OF: Hemolysis. Wasserman's complement-binding reaction. ELISA equipment and ready-made ELISA-plate. Immunofluorescence microscope and immunofluorescence test for Chlamydia trachomatis in cervical secretions.

PRACTICAL TASKS: Reading a Wasserman sample. Reporting positive and negative ELISA and immunofluorescence tests.

PRACTICAL CLASS №13 - 3 hours

Examination of the allergic condition. Biological preparations - vaccines and sera.

PURPOSE OF THE PRACTICAL CLASS: Introduction to allergy tests for the diagnosis of the fast and slow type of hypersensitivity. Organic products used for specific therapy and prevention of infectious diseases - sera and vaccines.

DEMONSTRATION OF: Different types of vaccines and the mandatory immunization calendar used in Bulgaria. Antitoxic and antibacterial sera. Allergy test type Mantoux on a guinea pig.

PRACTICAL TASKS: Mastering the technique of the Mantoux type allergic test - intradermal injection of allergens.

PRACTICAL CLASS - 3 hours

Laboratory diagnosis of diseases caused by viruses and rickettsiae. Test №2 on Infection and Immunity.

PURPOSE OF THE PRACTICAL CLASS: To introduce students to the particularities of the diagnosis of diseases caused by viruses and rickettsiae.

DEMONSTRATION OF: Tissue cultures - normal and with cytopathic effect. Chicken embryos Hearst phenomenon and Hearst reaction (HIA). ELISA plate with positive and negative samples for HbsAg. Immunofluorescence test.

PRACTICAL TASKS: Observation and drawing tissue cultures - normal and with cytopathic effect. Reporting the results from HIA in influenza, ELISA tests for hepatitis markers and HIV, immunofluorescence test for Chlamydia.

PRACTICAL CLASS №15 - 3 hours

Evaluation of the practical skills acquired during the semester.

PRACTICAL CLASS №16 - 2 hours

Methods for microbiological diagnosis of infectious diseases. General scheme for microbiological examination.

PURPOSE OF THE PRACTICAL CLASS: Applying the acquired knowledge in a consecutive scheme for microbiological diagnosis of infectious diseases.

DEMONSTRATIONS AND PRACTICAL TASKS: Introduction to the general rules for collecting and sending pathological materials. Preparation of a microscope slide from pathological material. Gram staining. Microscopy. Recognition of pure microbial cultures on various growth media. Identification tests - cultural; biochemical; determination of pathogenic factors; serotyping by Gruber agglutination test. Antibigram interpretation. Microscopy of ready-made slides.

PRACTICAL CLASS №17 - 2 hours

Microbiological diagnosis of staphylococcal and streptococcal infections. Microbiological examination of pus.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the most common causative agents of purulent infections in the human body. Methods for microbiological diagnostics.

DEMONSTRATION OF: Prepared microscope slides with Gram-stained staphylococci and streptococci. Demonstration of the cultural features of staphylococci and streptococci on different growth media and tests for their identification.

PRACTICAL TASKS: Identification of staphylococcal and streptococcal cultures on blood agar. Reporting alpha- and beta-hemolysis. Reading bacitracin and optochin test results. Performing a coagulase slide test. Coagulase tube test reading. Result interpretation of antibiograms of staphylococci, beta-hemolytic, and viridans streptococci. Interpretation of results from antistreptolysin reaction. Differential diagnosis between alpha-hemolytic streptococci and pneumococci. MRSA screen agar – result interpretation.

PRACTICAL CLASS №18 - 2 hours

Microbiological diagnosis of tuberculosis and leprosy. Microbiological examination in diseases caused by Streptococcus pneumoniae. Microbiological examination of sputum.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the methods of collection and microbiological examination of sputum, features of the specific inflammatory process. Introduction to the microbiological diagnosis of tuberculosis, leprosy, and pneumococci. Bioproducts for specific prevention and therapy.

DEMONSTRATION OF: Ready-made microscope slides: a) Tuberculosis bacteria in sputum smear, stained by Ziehl-Neelsen method; b) Pneumococci stained by Klett method. Inoculation of tuberculosis bacteria on Lowenstein-Jensen agar. Culture features of pneumococci on blood agar and glucose broth. Optochin and inulin test.

PRACTICAL TASKS: Preparation of a microscopic smear of sputum and Ziehl-Neelsen staining for the detection of tuberculosis bacteria. Reporting the positive and negative

optochin tests of alpha-hemolytic microorganisms. Reading an antibiogram of pneumococci on blood agar. Introduction to bioproducts for specific prophylaxis (BCG - vaccine) and allergic diagnosis (PPD) of tuberculosis.

PRACTICAL CLASS №19 - 2 hours

Microbiological diagnosis of diphtheria and pertussis. Microbiological examination of throat swabs.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the microbiological diagnosis of diphtheria and pertussis and bioproducts for specific prophylaxis and treatment.

DEMONSTRATION OF: Ready-made microscope slides with diphtheria bacteria stained by the Neisser method. Cultural features of diphtheria bacteria in the Löffler and Klauberg media. Growth of *Bordetella pertussis* on the Bordet-Gengou medium.

PRACTICAL TASKS: Microscopic observation of a ready-made microscope slide with *Bordetella pertussis*, Gram-stained. Preparation of a slide with pseudodiphtheria bacteria and Neisser staining. Introduction to bioproducts for specific prophylaxis (DTP and DT vaccines) and specific therapy for diphtheria (diphtheria antitoxin).

PRACTICAL CLASS №20 - 2 hours

Microbiological diagnosis of gas gangrene and tetanus. Microbiological examination of wound secretions.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the microbiological diagnosis of gas gangrene and tetanus, the particularities of collecting and sending pathological materials, and bioproducts for specific prevention and therapy.

DEMONSTRATION OF: Ready-made microscope slides of *C. perfringens* and *C. tetani*, stained by the Gram method. Culture media for anaerobic cultivation - Kitt-Tarozzi, thioglycolate broth, Zeissler, and Wilson-Blair agars and the cultural features of gas gangrene agents and the tetanus bacillus. Tetanic seizure of a mouse injected with blood from a sick patient - the seal posture.

PRACTICAL TASKS: Preparation of a microscope slide with Gram-stained wound swab containing clostridia. Introduction to bioproducts for specific prevention and therapy of gas gangrene and tetanus.

PRACTICAL CLASS №21 - 2 hours

Microbiological examination of CNS materials. Microbiological diagnosis and differential diagnosis of bacterial meningitis (*Neisseria meningitidis* and *Haemophilus influenzae*).

PURPOSE OF THE PRACTICAL CLASS: Mastering the differential microscopic diagnosis of bacterial meningitis.

DEMONSTRATION OF: Ready-made microscope slides from cerebrospinal fluid with *Neisseria meningitidis*, stained with methylene blue and Gram-stain, *H. influenzae*, stained by the Gram method and other microorganisms, causing bacterial meningitis. Cultural features of *H. influenzae* on chocolate agar, Levinthal medium, and blood agar – satellite phenomenon. Methods for microanaerophilic cultivation and cultures of *Neisseria meningitidis* on Levinthal agar and blood agar. Culture features of pneumococci, staphylococci, streptococci, and tuberculosis bacteria. Latex agglutination tests for the detection of microbial antigens in the cerebrospinal fluid of patients.

PRACTICAL TASKS: Preparation of a microscope slide with cerebrospinal fluid stained by the Gram method. Observation of ready-made microscope slides with *Neisseria meningitidis* and *H. influenzae*. Reporting the phenomenon of satellite growth in *H. influenzae*.

PRACTICAL CLASS №22 - 2 hours

Microbiological diagnosis of particularly dangerous infections plague, cholera, and anthrax.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the microbiological diagnosis of plague, cholera, and anthrax and the relevant bioproducts for specific prophylaxis and therapy.

DEMONSTRATION OF: Ready-made microscope slides - blood smear with *Bacillus anthracis*, stained by the Klett method for capsules, and *Vibrio cholerae* and *Yersinia pestis* both stained by the Gram method. Culture media, bacterial cultures, and biochemical tests to identify *Vibrio cholerae*. Ascoli precipitation test for anthrax antigen.

PRACTICAL TASKS: Microscopy and drawing of a slide with anthrax bacillus. Performing the Ascoli precipitation test. Immunofluorescence microscopy of anthrax bacilli. Observation of *C. albicans* filaments in a native smear.

PRACTICAL CLASS №23 - 2 hours

SEMINAR on the topic: Microbiological diagnostics of microorganisms, studied in practical classes from №1 to №7. Test №1.

Staphylococci. Streptococci. *Streptococcus pneumoniae*. Tuberculosis bacteria and other mycobacteria. *Mycobacterium leprae*. *Neisseria meningitidis*. Diphtheria bacteria. *Bordetella pertussis*. *Hemophilus influenzae*. Causative agents of gas gangrene. *Clostridium tetani*. *Bacillus anthracis*. *Vibrio cholerae*. *Yersinia pestis*.

PRACTICAL CLASS №24 - 2 hours

Microbiological examination of materials from the digestive system (feces). Microbiological diagnosis of bacterial dysentery, E.coli enteritis, salmonellosis. Food poisoning by Staphylococcus aureus, salmonella, clostridia (C. botulinum, C. perfringens). Microbiological examination of gastric mucosa biopsy material (Helicobacter pylori).

PURPOSE OF THE PRACTICAL CLASS: Introduction to the scheme for bacteriological examination of feces in diseases caused by members of the family Enterobacteriaceae (pathogenic *E. coli*, *Shigella*, *Salmonella*). Introduction to the microbiological diagnosis of food poisoning by bacterial agents and methods for bacterial diagnosis of *Helicobacter pylori* from biopsy material.

DEMONSTRATION OF: Microscope slide with Gram-negative microorganisms. Selective and differentiating media for enteric bacteria - Levine, deoxycholate-citrate agar with cultures of lactose-positive and lactose-negative bacteria; blood agar with *S. aureus*; culture media for clostridia. Biochemical tests for identification. Serotyping by agglutinating sera. Microscopic preparation of *H. pylori*.

PRACTICAL TASKS: Preparation of a microscope slide from a culture of *E. coli* and Gram staining. Performing biochemical tests - indole formation, acidity (MR), Foges-Proskauer test, etc. Performing type Gruber agglutination test. Inoculation of feces on a differentiating medium.

PRACTICAL CLASS №25 - 2 hours

Microbiological examination of urine. Microbiological diagnosis of pathogens causing urinary tract infections: opportunistic pathogens (E. coli, Klebsiella-Enterobacter-Serratia, Proteus-Providentia-Morganella, Pseudomonas) and obligatory pathogenic (streptococci, salmonella, leptospira, M. tuberculosis).

PURPOSE OF THE PRACTICAL CLASS: To introduce the rules for collection and sending urine for bacteriological examination and the methods for detection and isolation of the most common bacterial agents.

DEMONSTRATIONS OF: Cultural and biochemical features of *E. coli*, *Klebsiella*, *Proteus*, *Pseudomonas*. Inoculation of urine culture by the quantitative method with a calibrated loop. Demonstration of leptospira in a wet mount slide on dark-field microscopy.

PRACTICAL TASKS: Inoculation of urine on blood agar with calibrated loop. Interpretation of urine cultures with different degrees of bacteriuria. Observation and drawing of leptospira. Interpretation of an antibiogram of microorganisms isolated from urine.

PRACTICAL CLASS №26 - 2 hours

Microbiological examination for sexually transmitted infections caused by *Nisseria gonorrhoeae*, *Treponema pallidum*, *C. albicans*, chlamydia, and mycoplasmas.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the morphology and biology of the most commonly isolated microorganisms in sexually transmitted infections.

DEMONSTRATIONS OF: Ready-made microscope slide of urethral smear with *N. gonorrhoeae*; ready-made microscope slide with *Candida albicans*. Immunofluorescence slide with elementary bodies of chlamydia in cervical canal cells. Bacterial cultures of *Candida albicans* on Sabouroud agar; chlamydospores of *Candida albicans* on rice agar; filamentation test. ELISA. Positive CFT (Wasserman) for the diagnosis of syphilis.

PRACTICAL TASKS: Observation of *N. gonorrhoeae* in a urethral smear. Reporting positive and negative Wasserman tests.

PRACTICAL CLASS №27 - 2 hours

Microbiological examination of blood - blood culture. Causes of septic conditions: obligatory pathogenic (*Salmonella typhi*, *Brucella*, *Borrelia*) and facultative pathogenic bacteria. Problematic microorganisms causing nosocomial and iatrogenic infections (*Pseudomonas*, *Enterococcus*, MRSA, *C. difficile*).

PURPOSE OF THE PRACTICAL CLASS: Introduction to the causative agents of bacteremia and sepsis and methods for the microbiological examination of blood.

DEMONSTRATION OF: Blood culture media - soy-casein broth, thioglycolate broth, etc. *Salmonella* and *Proteus* cultures on Levin agar, deoxycholate citrate agar, and selenite broth. Biochemical tests for *Salmonella typhi* and *Proteus mirabilis*. Nutrient media for brucellosis. Gram-stained microscope slides with *Salmonella* and *Brucella*. Cultures of streptococci and staphylococci on blood agar and tests for their identification. Analytical Widal test in typhoid fever and Wright's agglutination for brucellosis.

PRACTICAL TASKS: Characterization of *Salmonella* and *Proteus*' growth on differentiating media. Reporting results from biochemical tests on *Salmonella typhi* and *Proteus mirabilis*. Interpretation of antibiograms of *Pseudomonas*. Detection of ESBL (+) *E. coli*. Detection of MRSA and MSSA strains on MRSA screen agar. Reading the results from an antibiogram of vancomycin-resistant enterococci. Reporting the sample titers of Widal and Wright tests.

PRACTICAL CLASS №28 - 2 hours

Microbiological diagnosis of diseases caused by viruses and rickettsiae.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the particularities of the diagnosis of viral and rickettsial diseases.

DEMONSTRATION OF: Inoculation of a chicken embryo. Cell cultures - normal and with cytopathic effect. Hearst phenomenon and Hearst reaction (RHA). ELISA equipment. ELISA samples for the diagnosis of viral markers (HBsAg, anti-HIV-1,2 antibodies, anti-HCV antibodies, etc.).

PRACTICAL TASKS: Observation and drawing of chicken embryos. Observation and drawing of cell cultures - normal and with cytopathic effect. Interpretation of ELISA results.

PRACTICAL CLASS №29 - 2 hours

Sanitary-microbiological examination of water, air, hospital environment. Sanitary-indicative microorganisms - E. coli, Enterococcus, C. perfringens, staphylococci, streptococci.

PURPOSE OF THE PRACTICAL CLASS: Introduction to the methods of collection, transport, and basic scheme for sanitary-microbiological examination of water. Mastering the criteria for determining microorganisms as nosocomial agents.

DEMONSTRATION OF: Nutrient media and materials needed to determine the microbial count and E.coli titer in the sanitary-microbiological examination of water. Biochemical tests for differentiation of E. coli and Klebsiella - IMVUC. Methods for qualitative determination of microorganisms in the air. Enterococcal culture media and cultures. Sherman's test.

PRACTICAL TASKS: Taking a hand wash for sanitary-microbiological examination and inoculation in broth. Identification of E. coli, Klebsiella, Enterococcus. Determination of biotype, serotype, resistotype, etc. to prove in-hospital agents. Characterization of the growth of Staphylococcus and Streptococcus strains on blood agar and identification according to specific tests.

EXERCISE №30 - 2 hours

Recapitulation of the students' practical skills, acquired during the two semesters with an evaluation mark.

Bibliography:

Textbooks for medical students in Microbiology - English training

Obligatory :

1. Review of Medical Microbiology and Immunology, Warren Levinson, 13 e. McGraw Hill Education, 2014, ISBN 978-0-07-181811-7, 789 pp or
2. Medical Microbiology. Patrick R. Murray, Ken Rosenthal, Michael Pfaller. 8 e. Elsevier, 2016, ISBN 978-0-323-29956- 5, 848 pp.

Recommended

1. Medical Microbiology. S. Baron, 4 ed, 2000, ISBN-10: 0-9631172-1-1, <http://www.ncbi.nlm.nih.gov/books/NBK7627/> or
2. Todar's online textbook of bacteriology. K. Todar, 2009, http://www.textbookofbacteriology.net/kt_toc.html
3. Medical microbiology / Patrick R. Murray et al . - 8th ed. - Philadelphia : Elsevier, 2016 . - 836 p. - (Student consult)
4. Cases in medical microbiology and infectious diseases / Peter H. Gilligan et al . - 4th ed. . - Washington : ASM Press, 2014 . - 589 p.
5. Laboratory exercises in microbiology : For students of medicine / Galina Zhelezova et al. - Sofia : St. Kliment Ohridski University Press, 2014 . - 256 p.
6. Mims' medical microbiology / Richard V. Goering et al. - 5th ed. . - Philadelphia: Elsevier, Saunders, 2013 . - 565 p. - (Student consult)
7. Manual for practical exercises in microbiology / Mariya Petrova Sredkova et al. - Pleven: Publ. center, Medical University - Pleven, 2012 . - 155 p.
8. Medical microbiology / Ed. Michael Ford . - 2nd ed. . - Oxford : Oxford University Press, 2014. - 484 p.

List of exam topics

SYLLABUS FOR THE SEMESTER EXAM

GENERAL MICROBIOLOGY

1. Subject and tasks of microbiology. Pasteur and Koch's contributions to the development of microbiology. Taxonomy of microorganisms - nomenclature and classification. General characteristics of the separate groups of microorganisms.

2. Morphology of bacteria - basic shapes, size. Methods for studying the morphology of bacteria. Bacterial structure - capsule, bacterial wall, cytoplasmic membrane, cytoplasm, and cytoplasmic inclusions. Flagella, pili, spores.

3. Bacterial genetics. Bacterial genotype and phenotype. Genetic apparatus in bacteria. The bacterial chromosome as a genetic system. Extrachromosomal genetic elements. Bacteriophages - main types, structure. Forms of the interaction of bacteriophages with bacteria - lytic cycle, moderate phage, phage conversion. Phagotyping. Practical application.

4. Microbial variability. Mutation. Mutagenic factors - chemical and physical, mechanism of action, practical significance, and application. Genetic exchange between bacteria: transformation, transduction, conjugation - mechanisms. Significance of bacterial and phage genetics. Genetic engineering. Modern genetic methods in clinical microbiology. DNA probes, PCR - polymerase chain reaction.

5. Bacterial physiology. Chemical composition of bacteria. Types of bacterial enzymes and practical significance. Metabolism in bacteria - catabolic and anabolic processes. Bacterial respiration. Bacterial nutrition. Nutrient transfer.

6. Growth and multiplication of bacteria. Growth phases and growth curves. Bacterial cultivation - basic principles, types of nutrient media. Growth factors in bacteria.

7. Influence of physical factors on microorganisms: heat, drying, lyophilization, light, atmospheric pressure, osmotic pressure, pH, radiation, sound energy. Sterilization. Sterilization methods. Influence of chemical factors on microorganisms; Mechanism of action. Oligodynamia. Disinfection. Types of disinfectants. Influence of biological factors on microorganisms: symbiosis, antagonism, antibiosis.

8. Antimicrobial agents. Antibacterial drugs - main groups and mechanisms of action. Mechanisms of resistance. Determination of bacterial susceptibility to antibiotics.

9. Viruses. Nature and properties. Cultivation methods. Classification. Rickettsia. Nature and properties. Cultivation methods. Classification.

10. The external environment as a factor in the spread of infectious diseases. Microflora of water, soil, and air. Microorganisms in food products, hospital rooms, etc. Sanitary-indicative microorganisms in the environment.

INFECTION AND IMMUNITY

11. Infection and infectious process. The role of microorganisms in the infectious process. Pathogenicity, virulence, contagiousness, invasiveness, toxigenicity. Pathogenicity factors. Pathogenesis of the infectious process. Characteristics of infectious disease. Forms of the infectious process. The role of the macroorganism in the infectious process. The role of the external environment for the occurrence and course of the infectious process. Epidemic process. Factors and mechanisms of transmission of infectious agents in the epidemic process.

12. Natural resistance. Protective role of the skin, mucous membranes, organs, and normal microflora. Humoral factors of natural resistance. Lysozyme. Complement. Interferon. Cellular factors of natural resistance. Phagocytosis. Inflammation.

13. Immunity. Definition. Types of immunity. Anatomy and structure of the immune system. Central and peripheral immune organs. Cells of the immune system.

14. Antigens. Types of antigens. Antigenic characteristics of microorganisms.

15. Humoral immunity. Characteristics of antibodies (immunoglobulins). Structure and functions of different classes of immunoglobulins. Mechanism of action of antibodies. Local immunity.

16. Cellular immunity. Cells and mechanism of action. Forms of cellular immunity. Cellular cooperation in the immune response.

17. Development of the immune response. Dynamics of the immune response - primary and secondary immune response. Humoral regulation of the immune response. Genetics and genetic control of the immune response. APC. The role of MHC - antigen recognition molecules.

18. Allergy - definition, and forms. Fast type of allergy - anaphylaxis, atopy, clinical significance. Cytotoxic allergic reactions. Allergic phenomena of immune complexes - Arthus phenomenon, serum sickness, clinical significance. Slow type of allergy - cell-mediated hypersensitivity. Contact dermatitis. Clinical significance.

19. Immunopathology. Immunopathological reactions and diseases. Immunological tolerance. Autoimmune diseases. Immunodeficiency conditions and diseases. Infectious diseases of the immune system.

20. Antigen-antibody reaction. Types of immune diagnostic reactions - agglutination, precipitation, neutralization - toxin-antitoxin, AST, virus-neutralizing reaction. Complement dependent - bacteriolysis, cytolysis, hemolysis, complement fixation test (CFT). Mechanism of reactions and application in microbiological diagnostics.

21. Labeled immune reactions - immunofluorescence (IFA), radioimmune (RIA) and enzyme-linked immunosorbent assay (ELISA) tests. Hybridoma biotechnology. Monoclonal antibodies.

22. Immunoprophylaxis and immunotherapy. Vaccines and serums. Immunomodulation.

SPECIAL MICROBIOLOGY

23. Staphylococci. Species, morphology, biology, biochemical productivity, pathogenic factors. Signs of pathogenicity in staphylococci. Diseases, immunity. Microbiological diagnosis. Antibiotic therapy. MRSA - clinical significance and diagnosis.

24. Streptococcus. Classifications. Morphology, biology, antigenic structure, pathogenic factors. Diseases. Immunity. Streptococcus as a cause of scarlet fever. Microbiological diagnosis. Antibiotic therapy. Pneumococci (*Streptococcus pneumoniae*). Morphology, biology, biochemical productivity. Antigenic structure. Pathogenic factors. Diseases. Immunity. Microbiological diagnosis. Therapy and specific prevention.

25. Meningococci (*Neisseria meningitidis*). Morphology, biology, biochemical productivity. Antigenic structure - serogroups. Pathogenic factors. Pathogenesis and clinical forms of meningococcal infection. Immunity. Microbiological diagnosis. Specific prevention and therapy. Gonococci (*Neisseria gonorrhoeae*). Morphology, biology, biochemical productivity. Pathogenic factors. Pathogenesis and clinical forms of gonococcal infection. Immunity. Microbiological diagnosis. Prevention and therapy.

26. Family Enterobacteriaceae. Groups of intestinal bacteria according to pathogenicity. General characteristics: morphology, biology, biochemical productivity. Antigenic structure. Pathogenic factors. Properties of endotoxin. Coli bacteria (*Escherichia coli*). Morphology, biology, biochemical productivity. Antigenic structure. Pathogenic factors. Diseases. Pathogenic *Escherichia coli* in the intestinal tract. Immunity. Microbiological diagnosis.

27. *Proteus*. *Providencia*. *Morganella*. Species. General characteristics: morphology, biology, biochemical productivity. Diseases. Therapy. Microbiological diagnosis. *Tribus Klebsiellae*. Species. Morphology, biology, biochemical productivity. Pathogenic factors. Diseases. Immunity. Microbiological diagnosis. Therapy. *Pseudomonas*. Morphology, biology, biochemical productivity. Pathogenic factors. Diseases. Microbiological diagnosis. Therapeutic problems.

28. *Salmonella*. General characteristics: morphology, biology, biochemical productivity. Kaufman antigenic characterization and classification. Antigenic formulas. Pathogenic factors. Pathogenesis, immunity, and specific prophylaxis in typhoid and paratyphoid fever. *Salmonella* - causes of food poisoning. Characteristic. Microbiological diagnosis.

29. Dysenteric bacteria (*Shigella*). Classification. Morphology, biology, biochemical productivity. Antigenic structure. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. *Helicobacter pylori*. Morphology, biology, biochemical productivity. Diseases. Microbiological diagnosis. Therapy. *Clostridium difficile*. Morphology, biology, biochemical productivity. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. Therapy.

30. The causative agent of plague (*Yersinia pestis*). Morphology, biology, biochemical productivity. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. Specific prevention and therapy. *Yersinia enterocolitica* - morphology, biology, biochemical productivity. Pathogenic factors. Pathogenesis. Microbiological diagnosis.

31. *Vibrio cholerae*. Morphology, biology, biochemical productivity. Antigenic structure. Serological types. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. Specific prevention and therapy.

32. Pertussis and pertussis bacteria (*Bordetella pertussis*, *B. parapertussis*). Morphology, biology. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. Specific prevention and therapy. *Haemophilus* bacteria. Morphology, biology. Antigenic structure. Pathogenic factors. Diseases. Immunity. Microbiological diagnosis. Specific prevention and therapy. *Listeria monocytogenes*. Common feature.

33. *Brucella*. Kinds. Morphology, biology, biochemical productivity. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. Specific prevention. Cause of tularemia (*Francisella tularensis*) - a common feature. *Legionella* (*Legionella pneumophila*) - a general characteristic.

34. Diphtheria bacteria (*Corynebacterium diphtheriae*). Morphology, biology, biochemical productivity. Pathogenic factors. Pathogenesis and immunity. Microbiological diagnosis. Specific prevention and therapy. Diphtheroid bacteria (*C. jeikeium*, *C. urealyticum*, *C. amiculatum*, *C. pseudo-diphtheriticum*). Clinical significance.

35. *Mycobacteria*. Tuberculosis bacteria (*Mycobacterium tuberculosis*). Morphology, biology, pathogenesis, clinical forms, immunity, allergy. Specific prevention of tuberculosis. Therapy. Microbiological diagnosis. The causative agent of leprosy (*Mycobacterium leprae*). Morphology, biology. Pathogenesis. Clinical forms. Prevention. Microbiological diagnosis.

36. Anthrax bacillus (*Bacillus anthracis*). Morphology, biology. Pathogenesis, clinical forms. Immunity. Specific prevention and therapy. Microbiological diagnosis. The cause of typhoid fever (*Borrelia recurrentis*). Morphology, biology. Pathogenesis, immunity. Microbiological diagnosis. The causative agent of Lyme disease (*Borrelia burgdorferi*). Pathogenesis. Immunity. Microbiological diagnosis.

37. Anaerobic spore-forming bacteria - genus *Clostridium*. General characteristics - morphology, biology. Tetanus bacillus (*Clostridium tetani*). Pathogenic factor. Pathogenesis and immunity. Specific prevention and therapy. Microbiological diagnosis. Causative agents of gas gangrene (*C. perfringens*, *C. novyi*, *C. septicum*, *C. histolyticum*). Pathogenic factors. Pathogenesis, immunity, prevention, and therapy. Microbiological diagnosis. The causative agent of botulism. Pathogenic factor. Pathogenesis and immunity. Prevention and specific therapy. Microbiological diagnosis.

38. Spirochetes (family Spirochaetaceae) - general characteristics. The causative agent of syphilis (*Treponema pallidum*). Morphology, biology. Pathogenesis and immunity. Microbiological diagnosis. *Leptospira*. Species. Morphology, biology. Antigenic structure. Pathogenesis and immunity. Microbiological diagnosis.

39. Mycoplasmas. Classification. Morphology, biology. Diseases. Microbiological diagnosis. L-forms of bacteria. Chlamydia (genus Chlamydia). Characteristics. Species. Causative agents of ornithosis and trachoma. Morphology, biology. Pathogenesis. Diseases. Microbiological diagnosis.

40. The causative agent of typhus (*Rickettsia prowazekii*). Morphology, biology. Pathogenesis and immunity. Specific prevention. Microbiological diagnosis. The causative agent of Marseille fever (*Rickettsia conorii*). Morphology, biology. Pathogenesis and immunity. Microbiological diagnosis. The causative agent of Q fever (*Coxiella burnetii*). Morphology, biology. Microbiological diagnosis.

41. Pathogenic fungi (Fungi). *Candida* (genus *Candida*). Morphology, biology. Pathogenesis, clinical forms. Microbiological diagnosis. Therapy. *Aspergillus*, *Cryptococcus*, *Actinomycetaceae*. Morphology, biology, diseases, and microbiological diagnosis.

SPECIAL VIROLOGY

42. Family Picornaviridae. Genus Enterovirus - poliovirus, Coxsackie viruses, ECHO viruses. Genus Rhinovirus. Genus Aphotavirus - the causative agent of foot-and-mouth disease.

43. Family Orthomyxoviridae. Influenza viruses.

44. Family Paramyxoviridae - parainfluenza viruses; the causative agent of mumps; the causative agent of measles. Respiratory syncytial virus.

45. Arbovirus infections and rubella. The family Togaviridae - genus Alphavirus and genus Rubivirus. Family Flaviviridae - causative agents of yellow fever, dengue, Pappataci fever, tick-borne encephalitis. Family Bunyaviridae - causes of Crimean hemorrhagic fever and hemorrhagic fever with renal syndrome.

46. Family Poxviridae - the causative agent of smallpox. Family Adenoviridae. Family Rhabdoviridae – the causative agent of rabies.

47. Causative agents of viral hepatitis (HAV, HBV, HCV, HDV, HEV)

48. Family Retroviridae - the cause of AIDS.

49. Family Herpesviridae - Herpes simplex virus type 1 and 2, Varicella-Zoster virus, Cytomegalovirus, Epstein-Barr virus, other herpes viruses.

50. Family Coronaviridae - SARS-CoV, MERS-CoV, SARS-CoV-2.