

CLINICAL COURSE VII: MEDICAL MICROBIOLOGY

GENERAL INFORMATION

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Study Programme	University Undergraduate Study of Medical Laboratory Diagnostics
Status of the course	mandatory
Year of study, semester	3 rd year, 6 th semester
ECTS	5
Workload (hours)	Lecture: 10; Seminars: 10; clinical exercises: 60
Expected number of students	30

COURSE DESCRIPTION

Course objectives

Get to know, understand and interpret the indications for microbiological testing in a particular infectious clinical syndrome, depending on the time, type and method of taking biological samples from different organ systems of the patient, and be trained for laboratory work with regard to specific microbiological testing with detailed knowledge of technology, laboratory and diagnostic process. The goal is to train students and provide them with basic knowledge for practical work in a clinical microbiological laboratory and to enable them to connect clinical diagnoses and samples with etiological laboratory diagnostics and synthesis of all methods in the microbiological processing of various biological samples and to instruct students in routine laboratory processes of microbiological processing of urine, stool, different swabs, blood, cerebrospinal fluid and other samples. Also, students will learn how to make and interpret microbiological findings and the sensitivity test of microorganisms to antimicrobial drugs, and will participate in the work of the serological laboratory and the molecular microbiology laboratory. Also, the goal of the course is to train students theoretically and practically for the implementation of basic measures to prevent and control hospital infections, considering the participation of this profile of laboratory workers in teamwork.

Enrolment requirements and entry competencies

No additional conditions

Learning outcomes at the Programme level

1.1, 1.2, 2.1, 2.2, 2.3, 2.6, 3.1

Learning outcomes at the course level

After completing lectures, seminars and exercises, independent study and passing the exam, students will be able to:

1. in the real environment of clinical laboratories apply the methods used in everyday medical laboratory diagnostics and clinical practice.
2. independently make microscopic preparations from biological samples and determine the presence of microorganisms: bacteria, viruses, fungi and parasites.
3. explain the possibilities of modern, routine diagnostic methods for the cultivation of bacteria, viruses, fungi and parasites, as well as with serological and molecular diagnostics in bacteriology, virology, mycology and parasitology.
4. participate in a team for the implementation of measures to prevent and control hospital

infections from the perspective of a laboratory worker.

Course content

Lectures:

L1. Introduction to clinical microbiology. Cultivation and isolation of microorganisms. Definition and extent of clinical microbiology laboratory work. Microorganisms – etiological agents of infectious diseases. Diagnostic principles in clinical microbiology. Diagnostic procedures in bacteriology. Diagnostic procedures in virology. Diagnostic procedures in parasitology. Diagnostic procedures in mycology. Sampling of material for microbiological tests. Direct and indirect diagnostics. Microbiological staining of direct samples. Cultivation and isolation of microorganisms.

L2. Serological tests in clinical diagnostics. Basic principles of serological reactions. Serology - definitions: paired sera, antibody titer and titer dynamics. Seroconversion. Serological tests in bacteriology: tests according to Widal, Weil-Felix, Wright, agglutination, immunoenzymatic tests, indirect immunofluorescence, western blot. Serological proof of spirochete infections (treponema, borrelia, leptospira). Application of serology in the diagnosis of viral infections. Diagnosis of hepatitis, HIV, herpesviruses and respiratory viruses. Infectious mononucleosis syndrome - etiology, samples and laboratory diagnostics. TORCH. Serological tests: agglutination, complement binding reaction (CBR), neutralization test (NT), Mason's and Paul-Bunell's reaction, immunoenzymatic test (EIA, ELISA), indirect immunofluorescence (IFA), Western-Blott (WB) - RIBA and test immunoperoxidase, etc. Application of serology in the diagnosis of parasites and fungi. Blood-borne viruses: hepatitis viruses and retroviruses (HIV, HTLV) – epidemiology, pathogenesis, laboratory diagnostics, treatment and prevention.

L3. Basics of molecular microbiology. Introduction to molecular microbiology. Diagnostic principles and procedures in molecular microbiology. Amplification of nucleic acids. Molecular microbiology in the diagnosis of etiological agents of infectious diseases: application in clinical microbiological diagnostics. Techniques of molecular microbiology in the diagnosis and typing of pathogens: in situ hybridization, polymerase chain reaction (PCR), RT-PCR, real time PCR, multiplex PCR, DNA microarray. Practical application of molecular diagnostics in bacteriology and virology. Detection of antimicrobial resistance and molecular epidemiology.

L4. Antibiotics, disinfection and sterilization. Antimicrobial chemotherapeutics: types, classification, mechanisms of action, therapeutic spectrum, testing of bacterial sensitivity to antibiotics, bacterial resistance and resistance mechanisms. The choice of antibiotics with regard to testing the sensitivity of bacteria to antibiotics. Creating an antibiogram and the importance of monitoring resistance. Rational pharmacotherapy. Reserve antibiotics. Resistant bacteria: MRSA, VISA; VRSA, VRE, PRSP, ESBL, resistant nonfermenters: *Pseudomonas aeruginosa* and *Acinetobacter baumannii*, multiresistant bacteria. Disinfection and sterilization: types of disinfectants and mechanism of action, selection of disinfectant. Sterilization procedures: types of sterilization, control of the sterilization procedure.

L5. Hospital infections. Definition and importance of infections associated with health care - hospital, nosocomial infections. Causes of hospital infections. HI reservoirs. Epidemiology of HI. Types and division of HI. Prevention and suppression of HI. Systematic supervision of HI. Control team - prevention and suppression of HI. Prevention measures for the occurrence of HI: hand hygiene, standard protective measures, isolation: contact, reverse. The importance of preventing the spread of resistant bacteria. Bundles of health care ("bundle of care") for the prevention of the most frequent HIs.

Seminars:

S1. Diagnostics of urogenital and sexually transmitted infections. Congenital infections. Urogenital infections. Etiology and epidemiology of urogenital and sexually transmitted infections. Causes of sexually transmitted diseases: *Neisseria gonorrhoeae*, *Treponema pallidum*, *Chlamydia*, *Mycoplasma* and *Ureaplasma*, HPV. Viruses and parasites causing urogenital infections. Samples for the diagnosis of urogenital and sexually transmitted infections. Diagnostic procedures and methods for diagnosing

infections of the urogenital tract. Microbiological processing of urine - method, results, clinical interpretation and diagnostic criteria. Pathogenesis, epidemiology, clinical syndromes, laboratory diagnostics, treatment, prevention and control of viruses that cause congenital infections: *Togaviridae* (Rubivirus), *Parvoviridae* (Parvovirus B-19), *Hepresviridae*, hepatitis viruses and HIV. TORCH – serological testing of pregnant women. Pathogenesis, epidemiology, clinical syndromes, laboratory diagnostics, treatment, prevention and control of viruses from the *Herpesviridae* family: herpes simplex virus (VHS), varicella zoster virus (VZV), Epstein-Barr virus (EBV), *Cytomegalovirus* (CMV), human herpes virus 6,7,8 (HHV-6, HHV-7 and HHV-8).

S2. Diagnostics of respiratory system infections. Characteristics and division of respiratory system infections. Epidemiology and etiology of respiratory tract infections. Causes from the respiratory tract. Microorganisms causing infections of the respiratory system. Bacterial infections of the respiratory tract. Atypical bacteria. Causes from the respiratory tract. Direct and indirect diagnosis of respiratory tract infections. The role of clinical microbiology and rational antimicrobial pharmacotherapy. Nosocomial infections of the respiratory system: pneumonia associated with ventilation. Tuberculosis - *Mycobacterium tuberculosis* - diagnosis and significance. Epidemiology of tuberculosis and resistance of mycobacteria to antituberculosis drugs. Treatment, prevention and control of tuberculosis. Viral infections of the respiratory tract: characteristics and division of viral infections of the respiratory system. Epidemiology and etiology of viral infections of the respiratory tract. Direct and indirect diagnosis of viral pathogens of respiratory tract infections. Respiratory viruses causing infections of the respiratory system: pathogenesis, epidemiology, clinical syndromes, laboratory diagnostics, treatment, prevention and control of adenovirus, orthomyxovirus, paramyxovirus, coronavirus. Influenza virus - "shift" and "drift". Flu pandemics and epidemics. The SARS virus. Respiratory syncytial virus and human metapneumovirus. Measles virus. Parotitis virus. Other viruses causing respiratory infections.

S3. Diagnostics of infections of the digestive system. Normal flora of the digestive tract and the role of intestinal flora. Characteristics and division of infections of the digestive system. Epidemiology and etiology of gastrointestinal tract infections. Pathogenesis and pathophysiology of infections of the digestive tract. Microorganisms causing infections of the digestive system. Bacterial causative agents of GIT infections: *Salmonella*, *Shigella*, *Yersinia*, *Campylobacter*, *Vibrio cholerae*. Digestive system viruses and viral gastroenteritis - structure, replication, pathogenesis, epidemiology, clinical syndromes, laboratory diagnostics, treatment, prevention and control of viruses causing gastrointestinal infections: rotavirus, adenovirus, astrovirus, calicivirus - norovirus. Viruses whose entry point into the body is the digestive system: picornaviruses. The importance of viral infections of the digestive system. Methods of rapid microbiological diagnosis of viruses causing gastroenteritis. Causes for microbiological diagnosis of digestive tract infections. Microbiological diagnosis of digestive tract infections. Identification of the most common causes of GIT infections. Microbiological treatment of stool. Differential and selective nutrient media. Salmonella serotyping. *H. pylori* – laboratory diagnostics. Treatment of GIT infections. Presentation and discussion of clinical cases of gastrointestinal infections.

S4. Diagnostics of infections of the central nervous system. Diagnosis of sepsis and endocarditis. Etiology and epidemiology of central nervous system infections. Pathophysiology of CNS infections. Clinical presentation of CNS infections. Bacterial meningitis and meningoencephalitis. Bacterial agents of CNS infections: *Neisseria meningitidis*, BHS-B, *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Listeria monocytogenes*, *Escherichia coli* K1. Viruses causing infections of the central nervous system. Viral tropism for CNS. Primary and secondary tropism. Clinical characteristics, samples, laboratory diagnostics, treatment and prevention of viral agents of CNS infections: tick-borne meningoencephalitis virus, lymphocytic choriomeningitis virus, herpesviruses, paramyxoviruses, picornaviruses, arboviruses (alphaviruses, flaviviruses, bunyaviruses). Rabies virus and rabies - epidemiology, pathogenesis, laboratory diagnostics, treatment and prevention. Laboratory diagnosis of STD infections: samples and sample processing. Biochemical and microbiological processing of cerebrospinal fluid. Direct microscopic preparation from cerebrospinal fluid. Treatment and

prevention of CNS infections. Vaccines. Bacteremia and sepsis: definitions, etiology, pathophysiology and laboratory diagnostics. Blood sampling for the diagnosis of invasive bacterial infections. Blood cultures - microbiological processing, clinical interpretation and significance of blood cultures. Infective endocarditis: definition, etiology, pathophysiology and microbiological diagnosis. Treatment of invasive bacterial infections. Presentation and analysis of clinical cases of meningitis, sepsis and infective endocarditis.

S5. Diagnostics of parasitic infections. Unicellular and multicellular parasites causing parasitic infections. Laboratory diagnostics of intestinal parasites. Laboratory diagnostics of blood and tissue parasites. Direct and indirect diagnostics of parasites. Life cycle, epidemiology, laboratory diagnostics, treatment and prevention of blood and tissue protists: *Trypanosoma spp.*, *Leishmania spp.* Genus *Plasmodium* (*P. malariae*, *P. vivax*, *P. ovale* and *P. falciparum*), filariae; *Toxoplasma gondii* serological diagnosis of toxoplasmosis. Arthropods – vectors for the transfer of blood and tissue protists. Life cycle, epidemiology, laboratory diagnostics of protists of the digestive and genitourinary systems: *Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium parvum*, *Trichomonas vaginalis*. Life cycle, epidemiology, laboratory diagnostics of roundworms: *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, *Strongyloides stercoralis*, *Enterobius vermicularis*, *Trichinella spiralis* - MIFC for finding eggs from stool, perianal impression, coproculture, trichineloscopy. Serological diagnosis. Life cycle, epidemiology, laboratory diagnosis of flatworms: *Taenia spp.*, *Echinococcus granulosus*, *Hymenolepis nana*, *Fasciola hepatica*, *Schistosoma spp.* - MIFC from stool, serological methods for diagnosis of echinococcosis.

Practices:

P1. Work in a microbiological laboratory and biosafety. Disinfection and sterilization. Preparation of nutrient media. Basics of work in a microbiological laboratory and safe work with infectious material. Biosecurity and biohazard. Methods of decontamination and sterilization of infectious material and incident procedures. Preparation of solid and liquid nutrients. Nutrient media for growing bacteria. Selective and non-selective nutrient media. Differential nutrient media. Transport nutrient media. Practical work: Sterilization and decontamination procedures in laboratory work. Work in the biosafety cabinet. Work in the laboratory for the preparation of nutrient media.

P2. Collection and processing of clinical samples: sampling of clinical material, storage and transport. Sampling of clinical samples for microbiological tests. Samples from: respiratory system, genital system, samples from the urinary system, from the digestive system, blood samples for blood culture, cerebrospinal fluid samples, other body fluids, abscesses, wounds, burns and exudates, ear and eye samples, bone samples, intravenous catheter, samples for serological and virological tests. Priority samples. Transport and labeling of samples, sampling time and storage of samples. Criteria for rejecting samples. Microbiological processing of individual samples depending on the place of sampling. Samples for anaerobic treatment. Practical work: Sampling of various clinical samples - sampling of biological material, preparing material for transport, receiving referrals and biological materials, and transporting the sample to the laboratory.

P3. Processing of clinical samples from the urogenital system. Processing of clinical samples from the urogenital tract. Urine implantation. Microbiological processing of urine. Diagnostics of the most important causes of urinary and urogenital infections. Identification of the causative agent of urinary infections. Development of a sensitivity test for bacteria causing urinary infections to antibiotics. Biochemical tests for the identification of members of the *Enterobacteriaceae* family. Micromorphology and macromorphology of enterobacteria - description of colonies and preparations. Micromorphology and macromorphology of other pathogens of urogenital system infections. Mycoplasmas - diagnostics and sensitivity testing. Practical work: Urine culture and interpretation of urine culture. Urine culture techniques (Sanford method, calibrated ezo method) Work in the laboratory for the diagnosis of urinary diseases and the processing of samples from the urogenital tract and microbiological diagnosis of the causative agent of urinary tract infections - identification of the causative agent and sensitivity testing to antibiotics.

P4. Processing of clinical samples from the respiratory system and other samples for the diagnosis of bacteriological diseases. Processing of clinical samples from the respiratory tract and other samples for the diagnosis of bacteriological diseases (smearings, punctates, biopsy samples, etc.). Planting samples from the respiratory tract and other samples for bacteriological diagnostics. Microbiological processing of samples for bacteriological diagnostics. Diagnostics of the most important causes of respiratory infections. Identification of clinically important bacteria isolated from the sample - tests for identification, preparation of microscopic preparations and macromorphology of colonies. Development of a sensitivity test for antibiotics of bacterial infections. Practical work: work in the laboratory for the diagnosis of bacteriological diseases and the processing of samples for bacteriological diagnosis and microbiological diagnosis of bacterial infections - identification of the causative agent and antibiotic sensitivity testing.

P5. Processing of cerebrospinal fluid, blood and other body fluids. Processing of clinical samples: cerebrospinal fluid, blood and other body fluids for the diagnosis of bacteriological diseases. Implantation of samples of cerebrospinal fluid, blood and other samples for bacteriological diagnosis and microbiological processing. Diagnostics of the most significant causes of invasive bacterial infections. Identification of clinically important bacteria isolated from the sample - tests for identification, preparation of microscopic preparations and macromorphology of colonies. Development of a sensitivity test for antibiotics of bacterial infections. Practical work: work in the laboratory for the diagnosis of bacteriological diseases and the processing of samples for bacteriological diagnosis and microbiological diagnosis of bacterial infections - identification of the causative agent and antibiotic sensitivity testing. Microbiological processing of primarily sterile and priority samples. Preparation of direct preparations from the sample and microscopy of stained samples.

P6. Work in a clinical laboratory for the diagnosis of urinary diseases. Processing of clinical samples from the urogenital tract. Urine implantation. Microbiological processing of urine. Diagnostics of the most important causes of urinary and urogenital infections. Identification of the causative agent of urinary infections. Development of a sensitivity test for bacteria causing urinary infections to antibiotics. Biochemical tests for the identification of members of the *Enterobacteriaceae* family. Micromorphology and macromorphology of enterobacteria - description of colonies and preparations. Micromorphology and macromorphology of other pathogens of urogenital system infections. Mycoplasmas - diagnostics and sensitivity testing. Practical work: work in a routine laboratory for the diagnosis of urinary diseases and the processing of samples from the urogenital tract and microbiological diagnosis of the causative agent of urinary tract infections - identification of the causative agent and sensitivity testing to antibiotics.

P7. Work in the clinical laboratory for the diagnosis of bacteriological diseases: processing of clinical samples from the respiratory system, processing of cerebrospinal fluid, blood and other samples. Processing of clinical samples: from the respiratory tract and other samples for the diagnosis of bacteriological diseases (smearings, punctures, biopsy samples, etc.), cerebrospinal fluid, blood and other body fluids for the diagnosis of bacteriological diseases. Planting samples from the respiratory tract, cerebrospinal fluid, blood and other samples for bacteriological diagnosis and microbiological processing. Diagnostics of the most important causes of invasive bacterial infections and causes of respiratory infections. Identification of clinically important bacteria isolated from the sample - tests for identification, preparation of microscopic preparations and macromorphology of colonies. Development of a sensitivity test for antibiotics of bacterial infections. Practical work: work in the laboratory for the diagnosis of bacteriological diseases and the processing of samples for bacteriological diagnosis and microbiological diagnosis of bacterial infections - identification of the causative agent and antibiotic sensitivity testing. Microbiological processing of primarily sterile and priority samples. Preparation of direct preparations from the sample and microscopy of stained samples.

P8. Diagnosis of tuberculosis. Laboratory for the preparation of nutrient media and sterilization. Sampling of clinical material, storage and transport. Processing of clinical samples for the diagnosis of

tuberculosis. Microbiological diagnostics of *Mycobacterium tuberculosis* - micromorphology and macromorphology of mycobacteria, laboratory diagnostics (cultivation, MGIT, sensitivity testing, rapid diagnostic methods, clinical samples, sensitivity testing to antituberculosis drugs. Specific staining: Ziehl Nielsen, auramine. Sampling of clinical samples for microbiological tests. Basics of work in microbiological laboratory and safe work with infectious material Biosafety and biohazard Methods of decontamination and sterilization of infectious material and incident procedures Samples from: respiratory system, genital system, samples from the urinary system, from the digestive system, blood samples for blood culture, cerebrospinal fluid samples, other body fluids, abscesses, wounds, burns and exudates, ear and eye samples, bone samples, intravenous catheter, samples for serological and virological tests Priority samples Transport and labeling of samples, time of sampling and storage of samples Criterion to discard samples. Microbiological processing of individual samples depending on the place of sampling. Samples for anaerobic treatment. Practical work: work in the laboratory for the diagnosis of tuberculosis and sample processing and microbiological diagnosis of tuberculosis and sensitivity testing to antituberculosis drugs. Sterilization and decontamination procedures in laboratory work. Work in the biosafety cabinet. Work in the laboratory for the preparation of nutrient media. Preparation of solid and liquid nutrient media. Nutrient media for growing bacteria. Selective and non-selective nutrient media. Differential nutrient media. Transport nutrient media. Sampling of various clinical samples - sampling of biological material, preparing material for transport, receiving referrals and biological materials, and transporting the sample to the laboratory.

P9. Processing of clinical samples from the digestive tract and laboratory diagnostics of infections of the digestive system. Processing of clinical samples from the digestive tract and laboratory diagnostics of infections of the digestive system. Implantation of stool samples and other samples from the digestive system. Diagnostics of the causative agents of infections of the digestive system - bacteria, viruses, parasites. Identification of clinically important bacteria isolated from causes of the digestive system: *Salmonella*, *Shigella*, *Yersinia*, *Campylobacter*, enteropathogenic *E. coli* - tests for identification, preparation of microscopic preparations and macromorphology of colonies. Salmonella serotyping. Creating an antibiotic sensitivity test. Diagnostics of viral infections of the digestive system: rotavirus, adenovirus, norovirus. Diagnostics of *Clostridium difficile*. Practical work: work in the laboratory for the diagnosis of intestinal and parasitological diseases and the processing of samples for the microbiological diagnosis of the causative agents of infections of the digestive system - identification of the causative agent and antibiotic sensitivity testing. Salmonella serotyping.

P10. Laboratory diagnostics of parasitic diseases. Processing of clinical samples for the diagnosis of parasitological diseases: stool processing - MIFC and other concentration methods, perianal impression. Microbiological diagnosis of blood and tissue parasites. Blood smear and thick drop. Giemsa-Romanowski staining. Practical work: work in the laboratory for the diagnosis of intestinal and parasitological diseases and the processing of samples for the microbiological diagnosis of parasitic diseases.

P11. Work in the laboratory for the diagnosis of intestinal and parasitological diseases: laboratory diagnosis of infections of the digestive system. Laboratory diagnostics of parasitic diseases. Processing of clinical samples from the digestive tract and laboratory diagnostics of infections of the digestive system. Implantation of stool samples and other samples from the digestive system. Diagnostics of the causative agents of infections of the digestive system - bacteria, viruses, parasites. Identification of clinically important bacteria isolated from causes of the digestive system: *Salmonella*, *Shigella*, *Yersinia*, *Campylobacter*, enteropathogenic *E. coli* - tests for identification, preparation of microscopic preparations and macromorphology of colonies. Salmonella serotyping. Creating an antibiotic sensitivity test. Diagnostics of viral infections of the digestive system: rotavirus, adenovirus, norovirus. Diagnostics of *Clostridium difficile*. Processing of clinical samples for the diagnosis of parasitological diseases: stool processing - MIFC and other concentration methods, perianal impression. Microbiological diagnosis of blood and tissue parasites. Blood smear and thick drop. Giemsa-Romanowski staining. Practical work: work in the laboratory for the diagnosis of intestinal and parasitological diseases and the processing of samples for the microbiological diagnosis of the

causative agents of infections of the digestive system - identification of the causative agent and antibiotic sensitivity testing. Salmonella serotyping. Sample processing for microbiological diagnostics of parasitic diseases.

P12. Laboratory diagnostics of diseases caused by fungi. Processing of clinical samples for the diagnosis of fungal diseases. Planting of samples on specific substrates and cultivation of fungi Identification of clinically significant fungi isolated from clinical material. Clinically significant yeasts, molds and dermatophytes. Isolation, identification and antifungal susceptibility testing. Practical work: work in the laboratory for the diagnosis of fungal diseases and the processing of samples for the microbiological diagnosis of fungi - identification of the causative agent and testing of sensitivity to antifungal drugs.

P13. Serological diagnosis of the causative agent of infectious diseases. Serological diagnosis of infectious diseases: Serological methods in bacteriology: tests according to Widal, Weil-Felix, Wright, agglutination, immunoenzymatic tests, indirect immunofluorescence. Serological proof of spirochete infections (Treponema, Borrelia). Application of serology in the diagnosis of viral infections: diagnosis of hepatitis, HIV, herpesvirus. Diagnosis of EBV and infectious mononucleosis. TORCH. Application of serology in the diagnosis of parasites and fungi. Diagnosis of *Clostridium difficile* toxins A and B. Practical work: work in a laboratory for serological diagnostics - preparation and processing of samples for serology. Serological procedures in the diagnosis of bacterial, viral and parasitological diseases.

P14. Molecular microbiological diagnostics. Diagnostic principles and procedures in molecular microbiology. Amplification of nucleic acids. Molecular microbiology in the diagnosis of etiological agents of infectious diseases: application in clinical microbiological diagnostics. Techniques of molecular microbiology in the diagnosis and typing of pathogens: polymerase chain reaction (PCR), real time PCR. Practical application of molecular diagnostics in microbiological laboratory diagnostics: molecular detection of chlamydia, human papillomavirus, cytomegalovirus and hepatitis virus (B and C). Practical work: work in a laboratory for molecular diagnostics - preparation and processing of samples for molecular diagnostic methods. Application of molecular diagnostics in the microbiological laboratory.

P15. Microbiological diagnosis of infections in hospitalized patients. Processing of clinical samples in the diagnosis of infections of hospitalized patients. Peculiarities and importance of certain groups of patients. Making microscopic preparations from direct samples. Priority causes for microbiological diagnostics. Processing of cerebrospinal fluid. Microscopy of direct Gram-stained preparations. Identification of resistant bacterial pathogens in hospitalized patients. Creating an antibiogram. Practical work: work in the laboratory for diagnosing infections in hospitalized patients. Sample processing, inoculation, cultivation, isolation, identification and antibiotic sensitivity testing of infectious agents in hospitalized patients.

Mode of teaching

Lectures, seminars and laboratory exercises.

Obaveze studenata

Attending all forms of classes is mandatory, and the student must pass all knowledge tests. A student can excuse himself from 30% of all classes. Unexcused absences, as well as absences outside the percentage of excused absences, must be compensated by colloquium.

Monitoring student work(Connectivity of learning outcomes, teaching methods and grading)

Exam method: written and oral exam.

Teaching activity	ECTS	Learning outcome	Student activity	Assessment methods	Grade points	
					Min.	Max.
Class attendance	0.25	1-4	Attendance in class and active participation	Records	3	5
Seminar paper	0.5	1-4	Preparation of seminar paper	Presentation of seminar	1	10

				paper		
Practical work (exercises)	0.75	1-4	Studying for the practical exam and class attendance	Practical exam	6	15
Final exam – written part	1.75	1-4	Continuous studying during classes	Written exam	16	35
Final exam – oral part	1.75	1-4	Continuous studying during classes	Oral exam	1	35
Ukupno	6					100

Evaluation of the obligations of students

Attending classes

The student must attend a minimum of 70% of all forms of teaching: exercises, seminars and lectures, and take all forms of knowledge testing. A student who misses seminars and/or exercises for more than 30% of the classes up to a total of 50% of all forms of classes must make up for the missed material by taking a colloquium.

Students' work is evaluated during classes and on the final exam. Students are evaluated numerically and descriptively: insufficient (1), sufficient (2), good (3), very good (4), excellent (5). During the course, the student will be able to collect a maximum of 100 grade points. Students can obtain a maximum of 30 points during classes through different forms of activities (see Table 1) and a maximum of 70 points on the final exam. The student must achieve more than 60% on the written part of the exam. The final grade represents the sum of the grade points achieved during the class and on the final exam.

Practical work (exercises):

The final colloquium - the practical part of the exam consists of 5 practical tasks that include microscopy of clinical preparations (3 pieces) and culture identification (2 pieces) on nutrient agar from a routine sample. A student must achieve at least 40% on the practical part of the exam in order to be able to take the final exam. Students can obtain a maximum of 15 grade points on the practical exam (see Table 2), depending on the percentage of correctly solved tasks. The final colloquium is organized after the end of classes and within each exam period as a practical part of the exam.

Evaluation of the final colloquium – practical exam

Percentage of correctly solved tasks (%)	Grade points (15)
40%	6
60%	9
80%	12
100%	15

Seminars:

During classes, the student can collect a maximum of 10 grade points by actively preparing and presenting the seminar, which is mandatory according to the following criteria:

1-2 grade points: the seminar meets the minimum criteria; 3-5 grade points: average answer with noticeable errors; 6-8 grade points: very good answer with minor errors; 9-10 grade points: exceptional answer

Lectures:

By attending lectures, a student can achieve 3-5 grade points according to the following scheme: participation in 60-79.99% of lectures is evaluated with 3 grade points, 80-89.99% 4 grade points, 90-100% 5 grade points.

Final exam:

A student who has properly completed all forms of teaching has acquired the right to signature and participation in final exam. The final exam is mandatory and consists of a written and an oral part. During the final exam, the student can receive a maximum of 70 grade points, of which 35 grade points are for the written part and 35 for the oral part.

The written part of the final exam consists of 70 questions with five possible answers, of which only one is correct. The minimum criterion for obtaining grade points is 60% of correctly solved questions. The points obtained on the written part of the final exam are converted into grade points according to the criteria listed in table 3. The points obtained on the final exam are added to the points obtained during classes. In the event that a student does not meet the minimum criteria on the final exam in the first exam period, he/she takes the final exam again in the next exam period.

Evaluation of the written part of the final exam

Percentage of correctly solved tasks (%)	Grade points(35)
60,00-69,99	8
70,00—79,99	16
80,00—89,99	24
90,00—94,99	32
95,00—100,00	35

The oral part of the final exam consists of 3 theoretical questions and is evaluated according to the following criteria:

1-8 grade points: the answer meets the minimum criteria; 9-17 grade points: average answer with noticeable errors; 18-27 grade points: very good answer with minor errors; 28-35 grade points: exceptional answer

Formulation of the final grade:

The grades obtained during the class are joined by the points obtained on the final exam.

Grading in the ECTS system is done by absolute distribution, i.e. based on the final achievement and is compared with the numerical system as follows:A — excellent (5): 80-100 grade points; B — very good (4): 70-79.99 grade points; C — good (3): 60-69.99 grade points; D— sufficient (2): 50-59.99 grade points.

Required reading (available in the library and through other media)

Title	Number of copies in the library	Availability through other media
Klinička mikrobiologija, urednice: Nataša Beader, Branka Bedenić, Ana Budimir. Medicinskanaklada, Zagreb:2019.	10	

Additional reading

1. Kalenić, S isuradnici: Medicinska mikrobiologija, drugo izmijenjeno I obnovljeno izdanje, medicinskanaklada, Zagreb: 2019.
2. Damani, N.: Priručnik o prevenciji i kontroli infekcija, 4.izdanje; Zagreb, Medicinskanaklada, 2019.

Quality assurance methods that ensure the acquisition of exit competencies

Anonymous, quantitative, standardised students' opinion survey on the course and teacher's work, carried out by the Quality Assurance Office of the Faculty of Medicine in Osijek.

