SVEUČILIŠTE U RIJECI - MEDICINSKI FAKULTET
UNIVERSITY OF RIJEKA - FACULTY OF MEDICINE

MEDICAL MICROBIOLOGY AND PARASITOLOGY

(19 pages)

Course: MEDICAL MICROBIOLOGY
Course Coordinator: prof. MAJA ABRAM, MD; PhD
Department: Microbiology and Parasitology
Study program: Integrated Undergraduate and Graduate University Study of Medicine in English
Study year: 3
Academic year: 2020/21

SYLLABUS

Course description (a brief description of the course, general instructions, where and in what form the lessons are organized, necessary equipment, instructions for attendance and preparation for classes, student obligations, etc.):

Course of **Medical Microbiology and Parasitology** is a **compulsory course** in the 3rd year of the Integrated Undergraduate and Graduate University Study of Medicine, which is carried out through 30 hours of lectures, 30 hours of seminars and 30 hours of laboratory exercises, in total of 90 hours (8 ECTS). Lectures and seminars are held on-line (MSTeams) and practical laboratory work in the Institute of Microbiology and Parasitology at the Faculty of Medicine in Rijeka.

The aim of the course is to provide students with the basic biological characteristics of microorganisms (bacteria, viruses, fungi and parasites) that cause human infections, their virulence factors, environmental resistance, their route of transmission, and the basis for human infection protection. Students will learn about different types of vaccines available for certain microbial infections. One of the goals is to teach basic groups of antimicrobial drugs, their spectrum of action, mechanism of action on the bacterial cell, and mechanisms of bacterial resistance to antimicrobial drugs. The aim is to introduce students with the possibilities of treating fungal, parasitic and viral infections. The students will also gain insight into the basic procedures of microbiological diagnostics, with particular emphasis on microbiological analysis of the most common clinical samples.

Course content:

General Medical Bacteriology: Micromorphology of bacteria, microscopy, microbiological stainings. Bacterial cell structure. Metabolism and genetics, growth and reproduction, nutrition and physical conditions of bacterial growth. Cell metabolism, energy production, and gene expression in the bacterial cell. Classification and nomenclature of bacteria. Bacterial antigens and vaccines. Immune response to infections. Resistance of bacteria to physical and chemical factors. Sterilization procedures and sterilization control. Disinfectants and disinfection. Antimicrobial drugs: Mechanism and spectrum of antibiotic activity, bacterial resistance to antimicrobial agents. Pathogenesis of bacterial infections: bacterial pathogenicity and virulence. Laboratory Diagnosis of Bacterial Infections.

Special Medical Bacteriology: Normal human microbiota. Medically significant Gram-positive and gram-negative bacteria. Atypical bacteria. Microbiological diagnosis of bacterial infections.

General Medical Mycology: Morphology, structure, reproduction, and Metabolism of clinically relevant fungi. Pathogenesis of fungal diseases. Factors of fungal virulence. Fungal diseases and laboratory diagnostics. Antifungal drugs.

Special Medical Mycology: Yeasts and molds of medical significance. Opportunistic and dimorphic fungi.

General Medical Parasitology: Parasitism as an ecological and medical concept. Laboratory diagnostics of parasitoses.

Special Medical Parasitology: Medically relevant parasites.

General Virology: General characteristics, classification, virus replication. Viral vaccines and antiviral drugs. Pathogenesis and laboratory diagnostics of viral diseases.

Special Virology: Medically Significant RNA and DNA Viruses. Prions.

Teaching:

Teaching is performed in the form of lectures, seminars and laboratory exercises, during 15 weeks. During the exercises, the teacher demonstrates and supervises the active participation of the students in performing the laboratory tests. During the course there will be compulsory midterm written exams, and a final laboratory exercise. At the end of the course a written part, and an oral part of the final exam will be held. By completing all teaching activities, and passing the final examination, the student acquires 8 ECTS credits.

Assigned reading:

1. Jawetz, Melnick i Adelberg "Medical Microbiology", 28th ed. New York: McGraw-Hill; 2018. (https://accessmedicine.mhmedical.com/Book.aspx?bookid=2629 - Access is provided via IP addresses for teachers and students)
2. Laboratory Excercises in Medical Microbiology – Practical Handbook for Medical Students, Institute of Microbiology and Parasitology, 2019-20.

Optional/additional reading:

1. Jawetz, Melnick i Adelberg "Medical Microbiology", 27th ed. New York: McGraw-Hill; 2017. (http://med-mu.com/wp-content/uploads/2018/06/Jawetz-Melnick-Adelbergs-Medical-Microbiology-27-edition.pdf)
2. Josephine A. Morello JA, Granato PA, Eckel Mizer H. Laboratory Manual and Workbook in Microbiology, 7th ed. http://site.iugaza.edu.ps/mwhindi/files/Laboratory_Manual_And_Workbook_In_Microbiology.pdf
2. Todar's Online Textbook of Bacteriology http://textbookofbacteriology.net/
3. Microbiology and Immunology On-Line (https://www.microbiologybook.org/)

COURSE TEACHING PLAN:

The list of lectures (with topics and descriptions):

P1 Overview of curriculum, literature and student obligations. Do we need microbiology in medicine?Classification of bacteria. (chapter 3)
Learning outcomes
- get acquainted with the microbiology course
- recall the rules in the taxonomy and clasification of living organisms, including microorganisms
- give examples of bacterial classification.

P2 Classification of antibiotics. Mechanism of action of antimicrobial drugs. Antimicrobial activity in vitro. (chapter 28)
Learning outcomes
- explain the terms antibiotic, selective toxicity, bactericidal and bacteriostatic action, broad and narrow-spectral antibiotic
- state the basic mechanisms of action of antimicrobial drugs on the bacterial cell
- explain the antibiotic susceptibility testing and explain the sensitivity categories (S, I, R)

P3 Basics of microbial genetics; Resistance to antimicrobial drugs. Multidrug resistant bacteria. (chapters 7, 28)
Learnign outcomes
- state the basic mechanisms of bacterial resistance
- state all three ways of horizontal gene transfer between bacteria
- describe each of the above mentioned ways
- give examples of multi-resistant bacteria of medical significance

P4 Normal human microbiota. Bacterial biofilm. Phenotypic resistance. (chapters 10; chapter 9, chapter 28)
Learnign outcomes
- indicate the differences between resident and transient (skin) microbiota
- connect the microbiota with health maintaince and causing the disease
- define the bacterial biofilm and describe the way it originates
- indicate at least three reasons why bacteria associate in biofilm
- link biofilm with infections and clinical failure of antimicrobial therapy
- link biofilm with antibiotic resistance; explain the term phenotypic resistance

P5 Mycobacteria. Aerobic, non-spore-forming, gram-positive bacilli. (Corynebacterium, Listeria, Erysipelothrix) (chapters 23, 12)
Learning outcomes
- describe mycobacteria and discuss their staining and cultivation characteristics
- indicate all obligatory pathogenic and most usal opportunistic mycobacteria
- summarize the most important laboratory tests for tuberculosis diagnosis

- indicate first line antimicrobial drugs for tuberculosis treatment
- describe the properties of coryneform bacteria and characteristics of pathogenic species
- identify virulence factors for *Corynebacterium diphtheriae* and associate them with the infection they cause
- discuss the possibility of diphtheria prevention

P6 «Atypical bacteria» – Mycoplasmas and cell wall-defective bacteria. Chlamydia. Rickettsia and related genera (chapters 25, 26, 27)
Learning outcomes
- describe the characteristics of mycoplasma and ureaplasma
- describe their virulence factors and associate them with the pathogenesis of the infections they cause
- discuss the selection of antimicrobial drugs for the treatment of infections caused by mycoplasmas
- state the most significant species from the genera *Chlamydia* and *Chlamydophila*
- describe the way chlamydia reproduce and discuss differences in relation to "typical" bacteria
- categorize the most important intracellular, atypical bacteria according to their characteristics and types of vectors
- connect them with the infections they cause and the ways of their transmitting

P7 Vibrio, Campylobacter, and Helicobacter; Yersinia (chapters 17, 19)
Learning outcomes
- describe micromorphology and ways of clustering of curved bacteria (vibrios, campylobacters)
- describe micromorphology and factors of helicobacter virulence and associate them with the infection they cause
- discuss the specificity of *H. pylori* laboratory diagnosis
- describe the properties of *Yersinia* and identify the most important species
- explain the way of plague transmission in connection with symptoms of infection and spread of pathogens (epidemics, pandemics)
- explain the pathogenesis of intestinal infections caused by *Y. enterocolitica*

P8 Pseudomonads and Acinetobacter; Stenotrophomonas, Burkholderia; Legionella, Bartonella (chapters 16, 22)
Learning outcomes
- Identify pseudomonas virulence factors and associate them with the infections they cause
- discuss the significance of acinetobacter in hospital infections
- discuss the possibility of antimicrobial treatment of infections caused by pseudomonas and acinetobacter
- describe the mode of *Legionella* transmission and connect it with human infections

P9 General properties of viruses. Pathogenesis and control of viral diseases (chapters 29, 30)
Learning outcomes
- describe the virus structure and group them into families depending on the nucleic acid and other characteristics
- connect viruses with the infections they cause
- group viral vaccines and give examples of certain types of vaccine
- indicate viral diseases for which there is specific treatment
- list and describe the mechanism of action of the most important antiviral drugs
- summarize the ways in which the virus can be propagated
- correlate steps in virus multiplication with the antiviral drugs mechanism of action

P10 Hepatitis viruses. Paramyxoviruses and Rubella virus (chapters 35, 40)
Learning outcomes
- group hepatitis viruses into families and list the most important characteristics and ways of transmission
- associate viruses with the infections they cause and the possible consequences
- indicate HBV antigens and their significance in the diagnosis of hepatitis B
- specify the diagnostic options, specific therapy and prevention of viral hepatitis
- classify particular genera within the *Paramyxoviridae* family and list the most important species linking them with the infections they cause
- describe the pathogenesis of specific viral infections (measles, mumps)
- describe the characteristics, structure and method of reproduction of Togaviride

-indicate the characteristics of rubella virus, pathogenesis of infection, diagnostic procedures and method of prevention

P11. Medical mycology – Mycoses and antifungal drugs (chapter 45)
Learning outcomes
- list fungi of medical importance and associate them with the infections they cause
- give examples of the most common causes of human mycoses
- list antifungal agents and group them according to the mechanism of action on the fungal cell
- describe the mechanisms of antifungal resistance

P12. Medical parasitology – intestinal protozoan infections, sexsually transmitted protozoan infections. Intestinal cestode (chapter 46)
Learning outcomes
- list protozoa that cause infections of the digestive and urogenital systems; describe their life cycles and relate it to the pathogenesis of infection; discuss microbiological procedures in the diagnosis of these protozoa
- describe and group multicellular parasites according to their structure and characteristics
- list tapeworms of medical importance; describe the life cycles of tenia and echinococcus
- associate individual flukes with the infections they cause

P13. Blood and Tissue protozoan infections (Plasmodium, Toxoplasma, Trypanosoma, Leishmania) (chapter 46)
Learning outcomes
- describe the life cycle and biological characteristics of plasmodiums; classify the most important species within the genus Plasmodium and associate them with the clinical picture
- list the most important species of the genera Trypanosoma and Leishmania and associate them with the infections they cause
- describe the pathogenesis of toxoplasmosis and the methods of transmission of the causative agent
- discuss the clinical significance of the infection caused by T. gondii

P14. Growth, survival, and death of microorganisms; Sterilisation and disinfection (chapter 4)
Learning outcomes
- list and describe all stages of bacterial growth (describe and explain the bacterial growth curve)
- define the terms biocide, bacteriostatic, bactericidal, sterilization, sepsis, asepsis and antiseptic
- specify and describe the mode of action of physical and chemical agents on the bacterial cell
- list sterilization procedures and provide examples of the use of particular procedures in medical practice
- list and describe the procedures for sterilization procedures control
- list and group disinfectants according to their effect and use

P15. Human cancer viruses; Emerging and re-emerging microorganisms (chapters 38, 41, 43)
Learning outcomes
- define and classify oncogenic viruses
- describe the characteristics of transformed cell viruses
- explain the reasons for the occurrence of new pathogens
- give examples of threatening viral infections and indicate the characteristics of the pathogens

The list of seminars with descriptions:

S1 Bacterial virulence factors. Pathogenesis of bacterial infections (chapters 2, 9)
Learning outcomes
- describe the structure of the bacterial cell and compare the structure of gram-negative and gram-positive bacteria
- explain the terms pathogenicity and virulence
- associate bacterial cell structure with virulence factors
- list the virulence factors of the bacteria and relate them to the pathogenesis of bacterial infections

S2 Clinical use of antibiotics. Antimicrobial drugs for systemic administration I part (chapter 28 – untill tetracyclines)
Learning outcomes

- group and give examples of individual antimicrobials depending on their activity and mechanism of action on the bacterial cell
- discuss the most important mechanisms of bacterial resistance

S3 Clinical use of antibiotics. Antimicrobial drugs for systemic administration II part (chapter 28)
Learning outcomes
- group and give examples of individual antimicrobials depending on their activity and mechanism of action on the bacterial cell
- discuss the most important mechanisms of bacterial resistance

S4 The staphylococci. The streptococci, enterococci, and related genera (chapters 13, 14)
Learning outcomes
- describe micromorphology and arrangement of gram positive cocci
- list the virulence factors of staphylococci, streptococci and enterococci and relate them to the infections they cause
- discuss microbiological procedures for the identification of staphylococci, streptococci, enterococci

S5. Spore-forming gram-positive bacilli: Bacillus and Clostridium. Infections caused by anaerobic bacteria (Physiology and growth conditions for anaerobes) (chapters 11, 21)
Learning outcomes
- describe the micromorphology of clostridia; describe staining procedures for visualization of bacterial spores; describe the pathogenesis of clostridial infections and discuss the methods of microbiological diagnosis of anaerobic bacteria
- group the bacteria according to to their oxygen requisite
- list the enzymes responsible for bacterial anaerobiosis
- specify features that indicate anaerobic infection

S6 The Neisseriae. Spirochetes and other spiral microorganisms (chapters 20, 24)
Learning outcomes
- describe micromorphology and arrangemets of gram negative cocci
- list virulence factors of Neisseria and relate them to the infections they cause
- classify spiral bacteria into genera and species
- list the most significant virulence factors of spirochetes and relate them to the infections they cause
- discuss the specifics of laboratory diagnostics procedures in spirochetal infection
- explain the principle of serological diagnostics; define antibody titer

S7 Enteric gram-negative rods (Enterobacteriaceae) (chapter 15)
Learning outcomes
- describe micromorphology and characteristics of enterobacteria
- name the most important genera and species that cause intestinal infections
- list the characteristics of Salmonella and relate them to the infections they cause
- link the route of Salmonella transmission with the onset of infection and control measures
- list significant multidrug-resistant enterobacteria and correlate them to hospital infections

S8 Haemophilus, Bordetella, Brucella, and Francisella. Moraxella. (chapters 18, 20)
Learning outcomes
- describe micromorphology and specific growth requirements for hemophilic cocobacilli
- list the virulence factors of Haemophilus and correlate them with the infections they cause
- discuss microbiological identification procedures for the growth of fastidious gram negative cocobacilli
- describe micromorphology and specific characteristics of moraxella and discuss their clinical significance

S9 Herpesviruses, Adenoviruses. Parvoviruses. Rabies (chapters 31, 32, 33, 42)
Learning outcomes
- describe the characteristics, structure, and mode of amplification of DNA viruses
- discuss pathogenetic mechanisms in the emergence of infections caused by DNA viruses
- classify herpesviruses and describe pathogenetic characteristics (latency; persistence; recurrence)
- describe the characteristics, structure and method of multiplication of rabies virus and relate them to the infection they cause.
- list and isolate the most significant way of transmitting rabies virus

S10 Orthomyxoviruses. HIV. Picornaviruses. Reoviruses, Rotaviruses (chapters 36, 37, 39, 44)
Learning outcomes
- classify individual genera within the Picornaviridae family and list the most significant species
- associate picornaviruses with the infections they cause
- describe the pathogenesis of specific viral infections (polio)
- describe the characteristics, structure and mode of reproduction of selected RNA viruses and relate them to the infection they cause
- describe the most important ways of transmitting selected RNA viruses (influenza virus, mumps, measles)
- specify laboratory procedures in diagnosis infections caused by selected RNA viruses
- describe the characteristics, structure and method of reproduction of human immunodeficiency virus (HIV) and relate it to the infection they cause.
- list the most significant ways of HIV transmition
- describe laboratory diagnosis of HIV infection

S11 Medical mycology (Candidiasis, Cryptococcosis, Aspergillosis, Mucormycosis) (chapter 45)
Learning outcomes
- specify the characteristics of yeasts and molds and identify those fungi that are the most common pathogens in clinical practice
- describe candida characteristics; list the most common species and associate them with sensitivity / resistance to available antifungals
- describe the characteristics and natural history of cryptococcosis
- describe the characteristics and virulence factors of aspergillus; its mode of transmission, and the clinical findings

S12 Medical parasitology – intestinal nematode (chapter 46)
Learning outcomes
- list and describe morpohology of round worms of medical importance
- describe the life cycle of trichinella and pinworm and relate them to diagnostic procedures

S13 Principles of diagnostic medical microbiology. Cases and Clinical Correlations. (chapters 47, 48)
Learning outcomes
- link clinical cases to the possible causative agents and correlate with microbiology diagnosis

S14 Principles of diagnostic medical microbiology. Cases and Clinical Correlations. (chapters 47, 48)
Learning outcomes
- link clinical cases to the possible causative agents and correlate with microbiology diagnosis

S15 Principles of diagnostic medical microbiology. Cases and Clinical Correlations. (chapters 47, 48)
Learning outcomes
- link clinical cases to the possible causative agents and correlate with microbiology diagnosis

The list of laboratory exercises with descriptions:

Lab1 Hand hygiene. Microscopic techniques and microscopic slides in microbiology. Simple staining. (chapter 2)
Learning outcomes
- list (and give an examples) all five moments (indication, occasion) for the hand hygiene
- apply hand hygiene (washing and rubbing) through 6 steps
- perform aseptic procedures
- prepare native and stained microscopic slides and perform simple bacteriological staining
- use a light microscope to visualize bacteria

Lab2 Direct diagnostics methods in microbiology. Complex staining. Cultivation of microorganisms (chapters 2, 5)
Learning outcomes
- list the factors necessary for bacterial growth on artificial nutrient media
- perform Gram staining
- specify direct microbiological procedures for the diagnosis of infectious diseases

- describe ways to identify bacteria

L**ab3 Antimicrobial activity *in vitro*. Methods for detection of antimicrobial resistance and interpreting of antimicrobial sensitivity testing results. (EUCAST standards)** (chapter 28)
Learning outcomes
- independently perform a disc diffusion method for determining susceptibility of bacteria to antimicrobials
- interpret the results of prepared disc diffusion test in accordance with current EUCAST standards
- link the findings of susceptibility test to choice of antimicrobial therapy in clinical practice
- read prepared dilution susceptibility and E-tests and interprete the results
- define the terms MIC and MBC
- identify some of the mechanisms of resistance in enterobacteria based on phenotypic tests (production of extended spectrum beta-lactamases-ESBLs; production of carbapenemase, etc)
- discuss the significance of bacterial resistance in clinical practice

Lab4 Diagnosis of infection by anatomic site (upper respiratory tract). Sampling and processing throat and nose swabs. Point of care test (POCT) for BHS-A. Laboratory procedures for the identification of streptococci and staphylococci (chapters 13, 14)
Learning outcomes
- name the most common causes of upper respiratory tract infections
- associate the bacterium with the infection they cause
- sample the throat and nose swabs
- determine the type of most common respiratory pathogens according to the microscopic or other characteristics
- perform tests to distinguish between staphylococci and streptococci

Lab5 Diagnosis of infection by anatomic site (lower respiratory tract). Management of sputum, endotracheal aspirate (ETA) and bronchoalveolar lavate (BAL) culture. Diagnostic laboratory tests in diagnosis of tuberculosis. Cultivation of anaerobic bacteria. Microscopic appearance of sporogenic bacteria. (chapters 11, 21, 23)
Learning outcomes
- assess specimen quality using the sputum Gram stain
- perform microbiological laboratory procedures for samples from the lower respiratory system
- recall the characteristics of M. tuberculosis and link them to diagnostic methods
- review and describe microscopic smears stained with Ziehl-Neelsen technique
- describe the principle of the IGRA test

Lab6 Diagnosis of infection by anatomic site (uro-genital tract). Microbiology diagnosis urinary tract infections. Diagnosis of Chlamydial infections. Serologic tests for syphilis. Diagnosis of Lyme disease (chapters 20, 24, 25, 26, 27)
Learning outcomes
- perform urine culture and determine the number of bacteria per milliliter of the urine sample
- explain the concept of indirect microbiological diagnosis and list serological tests
- read and interpret the prepared serological tests and relate them to the stage of infection
- list genera of spiral bacteria and compare them based on their micromorphology, mode of transmission
- explain the reasons for using serological tests in the diagnosis of syphilis, Lyme disease

Lab7 Diagnosis of infection by anatomic site (gastrointestinal tract-GIT). Management of GIT specimens (culture and non-culture based methods in identification of enterobacteria, campylobacter, helicobacter, etc.) (chapters 15, 17, 19,47)
Learning outcomes
- name obligate pathogenic gut bacteria; list selective and differential media for isolation of particular type of bacteria
- perform stool culture using different selective media
- identify specific intestinal pathogens based on colony morphology and biochemical tests
- perform agglutination tests for serotyping of *Salmonella*
- demonstration of the POCT test for diagnosis of helicobacter

Lab8 Management of clinical specimens from primary sterile body sites. Blood culture. Management of

cerebrospinal fluid (CFS). Laboratory methods for haemophilus and nonfermentative gram-negative bacilli identification (chapters 16, 18, 20, 22, 47)
Learning outcomes
- name the most common pathogens for blood and central nervous system infections
- associate the bacterium with the infection they cause
- make microscopic smears from positive blood cultures and CFS and recognize the micromorphology of bacteria
- perform direct disc-diffusion susceptibility test from positive blood cultures
- describe and explain the satellite phenomenon in the diagnosis of *H. influenzae*

Lab9 Laboratory diagnostics of viral infections. Diagnostics of herpesviruses infections (serology and Westernblot). Diagnostics of parvoviruses. (chapters 29, 31, 32, 33)
Learning outcomes
- discuss the differences between bacteria and viruses and link them to the laboratory diagnosis of viral infections
- list direct and indirect microbiological procedures in the diagnosis of viral infections and discuss their choice
- interpret prepared serological tests; describe and interpret the results of prepared Western blot tests in the diagnosis of herpes virus infections
- explain the terms sensitivity and specificity of a laboratory test

Lab10 Laboratory diagnostic of selected viral infections. Interpretation of microbiology results. (HIV, POCT for rotavirus; avidity – rubella) (chapters 35, 37, 39, 44)
Learning outcomes
- interpret prepared serological tests
- perform POCT for rotavirus/adenovirus infections
- explain the IgG avidity test in discrimination between recently acquired and distant infection

Lab11 Laboratory diagnosis of mycoses. (chapter 45)
Learning outcomes
- remember the characteristics and differences between yeasts and molds and relate them to the methods of microbiological diagnostics
- macroscopically and microscopically examine the prepared fungal cultures
- recognize the morphology of individual fungi based on macroscopic and microscopic characteristics

Lab12 Laboratory diagnosis in parasitology (chapter 46)
Learning outcomes
- prepare microscopic slides from stool samples; compare your own results with demonstration microscopic slides and identify cysts of individual protozoa and eggs of multicellular parasites
- recognize the morphological forms of plasmodium in prepared thick and thin blood smears and determine parasitemia
- examine formalin preparations and describe adult forms of tapeworms, roundworms and flukes
- examine the microscopic slides of individual ectoparasites and discuss their role in microbes transmission

Lab13 Principles of diagnostic medical microbiology. Cases and Clinical Correlations. (chapters 47, 48)
Learning outcomes
- according to the presented clinical cases select the most appropriate clinical samples for microbiology
- process the clinical specimen according to previously adopted rules and apply the correct microbiological procedures
- identify the most likely cause
- propose the most effective antimicrobial therapy (disscus laboratory role in the selection of antimicrobial therapy)

Lab14 Principles of diagnostic medical microbiology. Cases and Clinical Correlations. (chapters 47, 48)
Learning outcomes
- according to the presented clinical cases select the most appropriate clinical samples for microbiology
- process the clinical specimen according to previously adopted rules and apply the correct microbiological procedures

- identify the most likely cause
- propose the most effective antimicrobial therapy (disscus laboratory role in the selection of antimicrobial therapy)

Lab15 Principles of diagnostic medical microbiology. Cases and Clinical Correlations. (chapters 47, 48)
Learning outcomes
- according to the presented clinical cases select the most appropriate clinical samples for microbiology
- process the clinical specimen according to previously adopted rules and apply the correct microbiological procedures
- identify the most likely cause
- propose the most effective antimicrobial therapy (disscus laboratory role in the selection of antimicrobial therapy)

Students' obligations:

All forms of teaching, lectures, seminars and laboratory exercises are compulsory. Each student is expected to attend all teaching units, actively participate in discussions and laboratory exercises. A student may be absent from a total of 30% of teaching (maximum of 9 hours of each teaching form) solely for health reasons, which justifies with a medical certificate. If a student justifiably or unjustifiably misses more than 30% of teaching (ie more than 9 hours of a particular teaching form), he / she cannot continue to follow the course and loses the opportunity to attend the final exam. In doing so, he earned 0 ECTS credits and was rated with mark F.
To work in a microbiology lab, students must wear a protective coat and a protective mask to cover the nose and mouth, also must have a workbook (internal handbook) which they can buy at the Faculty of Medicine Rijeka. The handbook homepage lists the rules for safe work in the lab. Students are required to regularly perform hand hygiene (hand wash or hand rub) according to the instructions given in the introductory exercise, and are also indicated in the handbook and reported in the form of posters in the laboratory. When entering the laboratory for the first time, students are required to read all the rules and confirm with their signature that they will abide by them.
A record on attendance and activity in the classroom will be kept for each student. Knowledge will be continually evaluated and the students should prepare for the classes according to the syllabus. There will be 2 midterm written tests, and a final practical exercise. The final exam consists of a written and oral parts.
By completing all teaching activities, taking the obligatory midterms, practical excersice and passing the both parts of the final exam, the student earns 8 ECTS credits.

Assessment (exams, description of written / oral / practical exam, the scoring criteria):

ECTS grading system:

Student assessment is carried out in accordance with the current regulations of the University of Rijeka, adopted by the Faculty Council of the Faculty of Medicine in Rijeka.

Students' performance will be evaluated during the course and at the final exam. Out of a total of 100 credits, a **student can earn 50 credits during the course, and 50 credits at the final exam**.

The maximum of 50 credit points can be earned during the course, and at least 50% (25 credit points), are necessary in order to take the final exam. Students who earn 0-49.9% (0-24.9 credit points) during the course, earn an F (fail) grade, no ECTS credits, and must re-enroll in the course.

During the course, the **student can earn a maximum of 50 credit point** by actively participating in classes, completing all assignments, attending midterm exams, and final laboratory excercise **as follows**:

I. During the course, the following are evaluated:

a) **Midterm test I** will be held in the 7th week of course (on 20th November 2020.) - covers teaching material up to 13th November (general and part of special bacteriology). The midterm consists of 40 multiple-choice questions with five answers offered. Up to 20 points can be scored on the test (*each correct answer carries half a point*)

b) **Midterm II** (will be held on the 13th week of course (on 11th January 2021.) - includes a part of special bacteriology, virology, mycology and parasitology. The midterm consists of 40 multiple-choice questions with five answers offered. Up to 20 points can be scored on the test (*each correct answer carries half a*

point)

c) **final hands-on excercise** - Preparation for the exercises is mandatory. During the class, the teacher evaluates the activity and the acquired knowledge / skills of each student, which is tested in the final practical exercise where up to 10 points can be earned

Each midterm has one exam-repair for students who, for justifiable reasons, did not enter the midterm, either did not collect the minimum number of credit points or were not satisfied with the number of credit points collected (then their previous result is deleted).

Final Exam (50 credit points in total)

***Who MAY take the final exam*:** Students who have scored 25 or more credits during the course will take the final exam, where they can additionally earn a maximum of 50 credits.

Who MAY NOT take the final exam: Students who have earned less than 24.9 points during the course are not eligible for the final exam (they re-enroll in the following academic year).

The final exam consists of a written and an oral part. **The student in the final exam must pass at least 55% of the written test and be positively evaluated in the oral part of the exam**. The **scoring method** for the final exam is shown in **Table 2**.

Table 2. Assessment method at final written (55% pass threshold) and oral examination

Written part of the final exam	Oral part of the final exam
< 55%-impassable	Sufficient = 15 - 18
55 – 59,99% = 10	Good = 19 - 22
60 – 64,99% = 11	Very good = 23 - 26
65 – 69,99% = 12	Excellent = 27 - 30
70 – 74,99% = 13	
75 – 79,99% = 14	
80 – 84,99% = 15	
85 – 89,99% = 16	
90 – 94,99% = 18	
95 – 100% = 20	

Assessment in the ECTS system is done by absolute distribution, ie on the basis of final achievement (credit points earned during the course are added to the points from the final exam):

A = 90 - 100%
B = 75 - 89,9%
C = 60 - 74,9%
D = 50 - 59,9%
F = 0 - 49,9%

The grades in the ECTS system are translated into the numerical system as follows:

A = escellent (5)
B = very good (4)
C = good (3)
D = sufficient (2)
F = insufficient (1)

Other important information regarding to the course:

The course contents and all course related information as well as the midterm, and final exams terms are available on the web pages of the Faculty of Medicine, University of Rijeka and the Department of Microbiology and Parasitology.

COURSE SCHEDULE (for academic year 2020./2021.)

The practical implementation of teaching is subject to change depending on the epidemiological situation!

Date	Lectures (time and place)	Seminars (time and place)	Laboratory exercises (time and place)	Instructor
05.10.2020.	L1 (15,15-16,45) on line (MSTeams)			Prof. Maja Abram
06.10.2020.			Lab 1 (group 1) (8,00-9,30) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
			Lab 2 (group 1) (10,00-11,30) Microbiology	Assis. prof. Mateja Ožanič Valentina Marečić, PhD
			Lab 1 (group 2) (12,00-13,30) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
			Lab 2 (group 2) (14,00-15,30) Microbiology	Assis. prof. Mateja Ožanič Valentina Marečić, PhD
08.10.2020.			Lab 1 (group 3) (8,00-9,30) Microbiology	Assis. prof. Mateja Ožanič Valentina Marečić, PhD
			Lab 2 (group 3) (10,00-11,30) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
			Lab 1 (group 4) (12,00-13,30) Microbiology	Assis. prof. Mateja Ožanič Valentina Marečić, PhD
			Lab 2 (group 4) (14,00-15,30) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
12.10.2020.	L2 (15,15-16,45) on line (MSTeams)			Prof. Maja Abram
13.10.2020.		S1 (group 1) (12,15-13,45) on line (MSTeams)		Prof. Marina Šantić
		S2 (group 1) (14,00-15,30) on line (MSTeams)		Prof. Maja Abram
15.10.2020.		S1 (group 2) (12,15-13,45) on line (MSTeams)		Prof. Marina Šantić
		S2 (group 2) (14,00-15,30) on line (MSTeams)		Prof. Maja Abram
19.10.2020.	L3 (15,15-16,45) on line (MSTeams)			Prof. Maja Abram

20.10.2020.			Lab 3, Lab 4 (group 1) (12,15-13,35) Microbiology	Mirna Mihelčić, Phd Bojana Mohar-Vitezić, PhD
			Lab 3, Lab 4 (group 2) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
22.10.2020.			Lab 3, Lab 4 (group 3) (12,15-13,35) Microbiology	Mirna Mihelčić, Phd Bojana Mohar-Vitezić, PhD
			Lab 3, Lab 4 (group 4) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
26.10.2020.	L4 (15,15-16,45) on line (MSTeams)			Assoc. prof. Ivana Gobin
27.10.2020.		S3 (group 1) (12,15-13,45) on line (MSTeams)		Prof. Maja Abram
		S4 (group 1) (14,00-15,30) on line (MSTeams)		Bojana Mohar-Vitezić , PhD
29.10.2020.		S3 (group 2) (12,15-13,45) on line (MSTeams)		Prof. Maja Abram
		S4 (group 2) (14,00-15,30) on line (MSTeams)		Bojana Mohar-Vitezić , PhD
02.11.2020.	L5 (15,15-16,45) on line (MSTeams)			Prof. Marina, Šantić
03.11.2020.			Lab 5, Lab 6 (group 1) (14,00-15,20) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
			Lab 5, Lab 6 (group 2) (14,00-15,20) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
05.11.2020.			Lab 5, Lab 6 (group 3) (12,15-13,35) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
			Lab 5, Lab 6 (group 4) (14,00-15,20) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
09.11.2020.	L6 (15,15-16,45) on line (MSTeams)			Prof. Maja, Abram
10.11.2020.		S5 (group 1) (12,15-13,45) on line (MSTeams)		Assoc. prof. Ivana Gobin

		S6 (group 1) (14,00-15,30) on line (MSTeams)		Assis. prof. Mateja Ožanič
12.11.2020.		S5 (group 2) (12,15-13,45) on line (MSTeams)		Assoc. prof. Ivana Gobin
		S6 (group 2) (14,00-15,30) on line (MSTeams)		Assis. prof. Mateja Ožanič
16.11.2020.	L7 (15,15-16,45) on line (MSTeams)			Prof. Marina Šantić
17.11.2020.			Lab 7, Lab 8 (group 1) (14,00-15,20) Microbiology	Mirna Mihelčić, Phd Bojana Mohar-Vitezić, PhD
			Lab 7, Lab 8 (group 2) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
19.11.2020.			Lab 7, Lab 8 (group 3) (12,15-13,35) Microbiology	Mirna Mihelčić, Phd Bojana Mohar-Vitezić, PhD
			Lab 7, Lab 8 (group 4) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
20.11.2020.	10-10,40h	Midterm exam I. on line		
23.11.2020.	L8 (15,15-16,45) on line (MSTeams)			Assoc. prof. Ivana Gobin
24.11.2020.		S7 (group 1) (12,15-13,45) on line (MSTeams)		Assoc. prof. Ivana Gobin
		S8 (group 1) (14,00-15,30) on line (MSTeams)		Prof. Marina Šantić
26.11.2020.		S7 (group 2) (12,15-13,45) on line (MSTeams)		Assoc. prof. Ivana Gobin
		S8 (group 2) (14,00-15,30) on line (MSTeams)		Prof. Marina Šantić
30.11.2020.	L9 (15,15-16,45) on line (MSTeams)			Prof. Marina Šantić
01.12.2020.			Lab 9, Lab 10 (group 1) (14,00-15,20) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
			Lab 9, Lab 10 (group 2) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis.prof. Mateja Ožanič

03.12.2020.			Lab 9, Lab 10 (group 3) (12,15-13,35) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
			Lab 9, Lab 10 (group 4) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
07.12.2020.	L10 (16,00-17,30) on line (MSTeams)			Prof. Maja Abram
08.12.2020.		S9 (group 1) (12,15-13,45) on line (MSTeams)		Valentina Marečić, PhD
		S10 (group 1) (14,00-15,30) on line (MSTeams)		Mirna Mihelčić, PhD
10.12.2020.		S9 (group 2) (12,15-13,45) on line (MSTeams)		Valentina Marečić, PhD
		S10 (group 2) (14,00-15,30) on line (MSTeams)		Mirna Mihelčić, PhD
14.12.2020.	L11 (15,15-16,45) on line (MSTeams)			Prof. Maja Abram
15.12.2020.			Lab11, Lab 12 (group 1) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
			Lab11, Lab 12 (group 2) (14,00-15,20) Microbiology	Mirna Mihelčić, Phd Bojana Mohar-Vitezić, PhD
17.12.2020.			Lab11, Lab 12 (group 3) (12,15-13,35) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
			Lab11, Lab 12 (group 4) (14,00-15,20) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
21.12.2020.	L12 (15,15-16,45) on line (MSTeams)			Prof. Marina Šantić
22.12.2020.		S11 (group 1) (12,15-13,45) on line (MSTeams)		Assoc. prof. Ivana Gobin
		S12 (group 1) (14,00-15,30) on line (MSTeams)		Assoc. prof. Ivana Gobin
07.01.2021.		S11 (group 2) (12,15-13,45) on line (MSTeams)		Assoc. prof. Ivana Gobin
		S12 (group 2) (14,00-15,30) on line (MSTeams)		Assoc. prof. Ivana Gobin

11.01.2020.	L13 (15,15-16,45) on line (MSTeams)			Assoc. prof. Ivana Gobin
11.01.2021.	17-17,40	Midterm exam II. on line		
12.01.2021.			Lab 13, Lab 14 (group 1) (14,00-15,20) Microbiology	Prof. Maja Abram Assoc. prof. Ivana Gobin
			Lab 13, Lab 14 (group 2) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
14.01.2021.			Lab 13, Lab 14 (group 3) (12,15-13,35) Microbiology	Assoc. prof. Ivana Gobin Prof. Maja Abram
			Lab 13, Lab 14 (group 4) (14,00-15,20) Microbiology	Valentina Marečić, PhD Assis. prof. Mateja Ožanič
18.01.2020.	L14 (15,15-16,45) on line (MSTeams)			Prof. Marina Šantić
19.01.2021.		S13 (group 1) (12,15-13,45) on line (MSTeams)		Mirna Mihelčić, PhD
		S14 (group 1) (14,00-15,30) on line (MSTeams)		Assis. prof. Mateja Ožanič
21.01.2021.		S13 (group 2) (12,15-13,45) on line (MSTeams)		Valentina Marečić, PhD
		S14 (group 2) (14,00-15,30) on line (MSTeams)		Bojana Mohar-Vitezić, PhD
25.01.2020.	L15 (15,15-16,45) on line (MSTeams)			Prof. Maja Abram
26.01.2021.		S15 (group 1) (10,15-11,45) on line (MSTeams)		Assis. prof. Mateja Ožanič
		S15 (group 1) (12,00-13,30) on line (MSTeams)		Assoc. prof. Ivana Gobin
28.01.2021.	Final laboratory excercise		Lab 15 (group 1) (14,15-15,35) Microbiology	Assoc. prof. Ivana Gobin Mirna Mihelčić, PhD
	Final laboratory excercise		Lab 15 (group 2) (15,50-16,10) Microbiology	Prof. Maja Abram Assis. prof. Mateja Ožanič
	Final laboratory excercise		Lab 15 (group 3) (16,30-17,00) Microbiology	Mirna Mihelčić, PhD Bojana Mohar-Vitezić, PhD
	Final laboratory excercise		Lab 15 (group 4) (17,30-18,00)	Assoc. prof. Ivana Gobin

			Microbiology	

List of lectures and seminars:

	LECTURES (Topics)	Teaching hours	Location/Lecture room
L1	Overview of curriculum, literature and student obligations. Do we need microbiology in medicine? Classification of bacteria.	2	on line MSTeams
L2	Classification of antibiotics. Mechanism of action of antimicrobial drugs. Antimicrobial activity *in vitro*.	2	
L3	Basics of microbial genetics; Resistance to antimicrobial drugs. Multidrug resistant bacteria.	2	
L4	Normal human microbiota. Bacterial biofilm. Phenotypic resistance	2	
L5	Mycobacteria. Aerobic, non-spore-forming, gram-positive bacilli. (Corynebacterium, Listeria, Erysipelothrix)	2	
L6	«Atypical bacteria» – Mycoplasmas and cell wall-defective bacteria. Chlamydia. Rickettsia and related genera	2	
L7	Vibrio, Campylobacter, and Helicobacter; Yersinia	2	
L8	Pseudomonads and Acinetobacter; Stenotrophomonas, Burkholderia; Legionella, Bartonella	2	
L9	General properties of viruses. Pathogenesis and control of viral diseases	2	
L10	Hepatitis viruses. Paramyxoviruses and Rubella virus	2	
L11	Medical mycology – Mycoses and antifungal drugs	2	
L12	Medical parasitology – intestinal protozoan infections, sexually transmitted protozoan infections. Intestinal cestodes	2	
L13	Blood and tissue protozoan infections (Plasmodium, Toxoplasma, Trypanosoma, Leishmania)	2	
L14	Growth, survival, and death of microorganisms; Sterilisation and disinfection	2	
L15	Human cancer viruses; Emerging and re-emerging microorganisms	2	
		30	

	SEMINARS (Topics)	Teaching hours	Location/Lecture room
S1	Bacterial virulence factors. Pathogenesis of bacterial infections	2	
S2	Clinical use of antibiotics. Antimicrobial drugs for systemic administration I part	2	
S3	Clinical use of antibiotics. Antimicrobial drugs for systemic administration II part	2	
S4	The staphylococci. The streptococci, enterococci, and related genera	2	

S5	Spore-forming gram-positive bacilli: Bacillus and Clostridium. Infections caused by anaerobic bacteria (Physiology and growth conditions for anaerobes)	2	on line MSTeams
S6	The Neisseriae. Spirochetes and other spiral microorganisms	2	
S7	Enteric gram-negative rods	2	
S8	Haemophilus, Bordetella, Brucella, and Francisella. Moraxella	2	
S9	Herpesviruses, Adenoviruses. Parvoviruses. Rabies	2	
S10	Orthomyxoviruses. HIV. Picornaviruses. Reoviruses, Rotaviruses	2	
S11	Medical mycology (Candidiasis, Cryptococcosis, Aspergillosis, Mucormycosis	2	
S12	Medical parasitology – intestinal nematodes	2	
S13	Principles of diagnostic medical microbiology. Cases and Clinical Correlations	2	
S14	Principles of diagnostic medical microbiology. Cases and Clinical Correlations	2	
S15	Principles of diagnostic medical microbiology. Cases and Clinical Correlations	2	
		30	

	LABORATORY EXCERCISES (Topics)	**Teaching hours**	**Location/Lecture room**
Lab1	Hand hygiene. Microscopic techniques and microscopic slides in microbiology. Simple staining.	2	Institute of Microbiology&Parasitology
Lab2	Direct diagnostics methods in microbiology. Complex staining. Cultivation of microorganisms	2	
Lab3	Antimicrobial activity in vitro. Measurment of antimicrobial activity. EUCAST standards.	2	
Lab4	Diagnosis of infection by anatomic site (upper respiratory system). Sampling and processing thoroat and nose swabs. POCT for BHS-A. Laboratory procedures for the identification of streptococci and staphylococci	2	
Lab5	Diagnosis of infection by anatomic site (lower respiratory tract). Management of sputum, endotracheal aspirate (ETA) and bronchoalveolar lavate (BAL) culture. Laboratory tests in diagnosis of tuberculosis. Cultivation of anaerobic bacteria. Microscopic appearance of sporogenic bacteria.	2	
Lab6	Diagnosis of infection by anatomic site (uro-genital tract). Microbiology diagnosis of urinary tract infections. Diagnosis of Chlamydial infections. Serologic tests for syphilis. Diagnosis of Lyme disease	2	
Lab7	Diagnosis of infection by anatomic site (gastrointestinal tract-GIT). Management of GIT specimens (culture and non-culture based methods in identification of enterobacteria, campylobacter, helicobacter, etc.)	2	
Lab8	Management of clinical specimens from primary sterile body sites. Blood culture. Management of cerebrospinal fluid (CFS). Laboratory methods for identification of haemophilus and nonfermentative gram-negative bacilli	2	
Lab9	Laboratory diagnostics of viral infections. Diagnostics of HSV infections (serology and Westernblot). Diagnostics of parvoviruses.	2	

Lab10	Laboratory diagnostic of selected viral infections. Interpretation of microbiology results. (HIV, POCT for rotavirus; avidity – rubella)	2	
Lab11	Laboratory diagnosis of mycoses	2	
Lab12	Laboratory diagnosis in parasitology	2	
Lab13	Principles of diagnostic microbiology. Cases and Clinical Correlations.	2	
Lab14	Principles of diagnostic microbiology. Cases and Clinical Correlations.	2	
Lab15	Final laboratory exercise	2	
		30	

	FINAL EXAM DATES
1.	11.02.2021.
2.	25.02.2021.
3.	09.07.2021.
4.	02.09.2021.
5.	21.09.2021.