# MEDICAL MICROBIOLOGY

## INTEGRATED ACADEMIC STUDIES OF MEDICINE

### SECOND YEAR OF STUDIES

School year 2024/2025

# MEDICAL MICROBIOLOGY

The course counts for 6 ECTS credits. It includes 6 classes (3 theoretical classes and 3 practical classes in small group) weekly.

## TEACHERS AND ASSOCIATES:

| N | Name and surname | Contact email | Title |
|---|---|---|---|
| 1. | Dejan Baskić | phi28@fmn.kg.ac.rs | Full Professor |
| 2. | Sanja Matić | | Aaistant Professor |
| 3. | Milica Stojković | | Teaching Facilitator |
| 4. | Tijana Marković | | Teaching Facilitator |
| 5. | Ana Todorović | | Teaching Facilitator |

## COURSE STRUCTURE:

| **Modul** | **Module Name** | **Weeks** | **Lectures** | **Small group work** | **Module Coordinator** |
|---|---|---|---|---|---|
| 1 | Bacteriology | 7 | 3 | 3 | Prof. Dejan Baskić, PhD |
| 2 | Virology | 5 | 3 | 3 | Prof. Dejan Baskić, PhD |
| 3 | Parasitology and mycology | 3 | 3 | 3 | Prof. Dejan Baskić, PhD |
| Σ45+45=90 | | | | | |

# GRADING:

The grade corresponds to the total points earned (see tables). Points can be earned in two ways:

**PRE-EXAM ACTIVITIES**: Students can earn up to 30 points through pre-exam activities, as outlined in the attached table. To pass the module, a student must achieve more than 50% of the possible points in these activities.

**FINAL EXAM**: The final written exam is worth up to 70 points.

The method of assessment and grading follows the criteria outlined in the attached table

| MODULE | | MAXIMUM POINTS | | |
|---|---|---|---|---|
| | | **Pre-examination activities** | **Final exam** | |
| | | **Colloquiums** | **Written exam** | Σ |
| 1 | Bacteriology (7 weeks) | 14 (28 questions) | | |
| 2 | Virology (5 weeks) | 10 (20 questions) | | |
| 3 | Parasitology and mycology (3 weeks) | 6 (12 questions) | | |
| | **Σ** | **30** | **70** | **100** |

To pass the exam, a student must achieve more than 50% of the available points in both the pre-exam activities and the final exam, which means the student must:

- Pass the pre-exam activities by earning more than 50% of the points allocated for these activities through four teaching colloquiums.
- Pass the final exam by obtaining more than 50% of the points allocated for the final written exam.

**The final grade is formed as follows:**

| number of points won | grade |
|---|---|
| 0- 50 | **5** |
| 51 - 60 | **6** |
| 61 - 70 | **7** |
| 71 - 80 | **8** |
| 81 - 90 | **9** |
| 91 - 100 | **10** |

# LITERATURE:

| NAME OF THE TEXTBOOK | AUTHORS | PUBLISHER | LIBRARY |
|---|---|---|---|
| Medical Microbiology 8th Edition, 2016 | Patrick R. Murray, Ken Rosenthal, Michael A. Pfaller | Elsevier Inc. Science | YES (e-book) |
| **All lectures and material for small group work are available on the website of the Faculty of Medical Sciences: www.medf.kg.ac.rs** | | | |

# CURRICULUM

## FIRST MODULE: BACTERIOLOGY

### UNIT 1 (WEEK ONE): **BASIC CHARACTERISTICS OF THE BACTERIAL CELL**

**Theoretical classes: 3**

Classification and taxonomy of microorganisms. Taxonomy and classification of bacteria. Morphology and structure of bacterial cells. Physiological conditions for the growth and reproduction of bacteria. Bacterial cell metabolism. Bacterial genetics.

**Practical classes: 3**

Introduction to work in a microbiological laboratory. Safety and levels of protection in a microbiological laboratory. Types and handling of samples for microbiological analysis. Types of microscopes and microscopy techniques. Culture media used in microbiology. Gram staining.

### UNIT 2 (WEEK TWO): **INFECTION, PATHOGENICITY, VIRULENCE AND DIAGNOSTICS**

**Theoretical classes: 3**

Human microbiome. Ecological associations. Opportunistic and healthcare-associated infections. Pathogenesis of infectious diseases. Establishment and spread of infection. Tissue damage. Transmission to a new host. Diagnostics.

**Practical classes: 3**

Virulence factors and bacterial toxins. Mechanisms of action of bacterial toxins.

### UNIT 3 (WEEK THREE): **PREVENTION AND TREATMENT OF INFECTIOUS DISEASES**

**Theoretical classes: 3**

Active and passive immunization. Antimicrobial agents. Mechanisms of action of antimicrobial agents.

**Practical classes: 3**

Asepsis, antisepsis, sterilization, disinfection, resistance testing, antibiogram.

### UNIT 4 (WEEK FOUR**): PATHOGENS RESPONSIBLE FOR PYOGENIC INFECTIONS. GRAM-POSITIVE AND GRAM-NEGATIVE COCCI AND BACILLI.**

**Theoretical classes: 3**

*Staphylococcus, Streptococcus, Enterococcus, Neisseria, Acinetobacter, Haemophilus, Bordetella, Legionella*.

**Practical classes: 3**

Microbiological approach to diagnosing infectious diseases. Diagnosis and prevention of pyogenic infections.

## UNIT 5 (WEEK FIVE): **PATHOGENS RESPONSIBLE FOR DIARRHOEAL SYNDROMES. ENTEROBACTERIACEAE AND OTHER GRAM-NEGATIVE BACILLI**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| *Enterobacteriaceae: Escherichia, Klebsiella, Enterobacter, Proteus, Morganella, Providencia.* Pathogenous: *Salmonella, Shigella, Yersinia.* Other Gram-negative bacilli*: Pseudomonas, Vibrio, Campilobacter, Helicobacter.* | Introduction to the immunological approach in diagnosing infectious diseases. Diagnosis and prevention of bacterial diarrheal syndromes. |

## UNIT 6 (WEEK SIX): **PATHOGENS RESPONSIBLE FOR TUBERCULOSIS, LEPROSY AND DIPHTHERIA. ANAEROBIC AND SPOROGENIC BACTERIA**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| *Mycobacterium: M. tuberculosis, M. leprae.* Non-spore-forming Gram-Positive Rods*: Listeria, Lactobacillus, Corynebacterium, Actinomyces, Nocardia, Streptomyces, Rhodococcus. Anaerobiasis and Anaerobic Bacteria*. Gram-Negative Rods and Cocci*: Bacteroides, Fusobacterium, Prevotella, Porphyromonas, Veillonella.* Gram-Positive Rods and Cocci: *Bifidobacterium, Propionibacterium, Peptostreptococcus. Spore-Forming Bacteria.* Anaerobic Gram-Positive Rods: *Clostridium. Aerobic Gram-Positive Rods: Bacillus.* | Diagnosis and prevention of infections caused by mycobacteria, anaerobic, and spore-forming bacteria. Ziehl-Neelsen staining. |

## UNIT 7 (WEEK SEVEN): **PATHOGENS RESPONSIBLE FOR ZOONOSES AND SEXUALLY TRANSMITTED DISEASES. SPIRAL AND OBLIGATE INTRACELLULAR BACTERIA**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| Intracellular bacteria: *Rickettsia, Coxiella, Bartonella.* Spiral bacteria*: Borrelia, Leptospira.* Enterobacteria: *Yersinia pestis*. Pathogens responsible for sexually transmitted diseases. Spiral bacteria: *Treponema pallidum.* Obligate intracellular bacteria: *Chlamydia*. Bacteria lacking a cell wall: *Mycoplasma* and *Ureaplasma*. Other bacteria: *Gardnerella vaginalis, Haemophilus ducreyi*. | Immunological approach in diagnosing infectious diseases: ELISA and western blot. Diagnosis and prevention of bacterial zoonoses and sexually transmitted infections. |

# SECOND MODULE: VIROLOGY

## UNIT 8 (WEEK EIGHT): **BASICS OF THE VIROLOGY**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| Taxonomy and classification of viruses. The structure of the virus. Viral genome. Replication of the virus. genetics of the virus. The relationship between the virus and the host cell. Tumor viruses. | Antiviral drugs. The mechanism of action of antiviral drugs. Interferons. |

## UNIT 9 (WEEK NINE): **VIRUSES IMPORTANT FOR THE DEVELOPMENT OF INFECTIONS OF THE CENTRAL NERVOUS SYSTEM AND RESPIRATORY TRACT**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| *Picornaviridae: Enterovirus (Poliovirus, Coxackievirus, Echovirus), Rhinovirus. Orthomyxoviridae*: *Influenza virus. Paramyxoviridae: Mumps virus, Parainfluenza virus, Respiratory syncytial virus. Coronaviridae*: MERS-CoV, SARS-CoV, SARS-CoV-2. | Molecular-biological approach in the diagnosis of infectious diseases. Polymerase chain reaction. Sequencing. Diagnosis and prevention of CNS and respiratory viral infections. |

## UNIT 10 (WEEK TEN): **VIRUSES IMPORTANT FOR THE DEVELOPMENT OF DIARRHOEAL SYNDROME ARBOVIRUSES, ZOONOSES AND ONCOGENIC VIRUSES**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| *Reoviridae (Rotavirus)* and other viruses important in the development of diarrheal syndrome: *Astroviridae, Caliciviridae* (*Norwalk virus), Adenoviridae: Adenovirus.* Arbovirus infections: *Flaviviridae, Togaviridae (Alphavirus), Bunyaviridae*. Viral zoonosis: *Arenaviridae, Filoviridae, Rhabdoviridae. Rabies virus. Oncogenic viruses: Papiloma-virus. Poliomaviridae: Poliomavirus (JCV, BK, SV40). Parvoviridae: Parvovirus B19.* | Diagnostics and prevention of viral diarrheal syndromes, arbovirus and zoonotic infections. Diagnostics of HPV infection, prevention and importance in the occurrence of cervical cancer. |

## UNIT 11 (WEEK ELEVEN): **HERPES VIRUSES AND OTHER VIRUSES RESPONSIBLE FOR RASH FEVER**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| *Herpesviridae. Herpes simplex virus 1 u 2. Varicella-zoster virus. Cytomegalovirus, Epstein-Barr virus*. HHV6, HHV7, HHV8. *Paramyxoviridae: Morbillivirus. Rubivirus.* Congenital and postnatal rubella. *Poxviridae:* | Diagnosis and prevention of herpes virus infections and other triggers of rash fever. TORCH. |

| | |
|---|---|
| *Variola virus, Vaccinia virus, Molluscum contagioisum virus* | |

UNIT 12 (WEEK TWELVE): **HEPATITIS VIRUSES. RETROVIRUSES AND PRIONS**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| HAV, HEV, HBV, HDV, HCV, HGV. *Retroviridae*: HIV, HTLV. Prions and viroids. | Diagnosis and prevention of viral hepatitis and retroviral infections |

# THIRD MODULE: PARASITOLOGY AND MYCOLOGY

UNIT 13 (WEEK THIRTEEN): **PROTOZOA**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| Taxonomy and classification of protozoa, helminths and fungi. Morphology and physiology of protozoa, helminths and fungi. Amoebas and ciliates: *Entamoeba histolytica, Entamoeba coli, Iodamoeba butschlii, Endolimax nana, Balantidium coli, Blastocystis hominis.* Flagellates of the digestive and urogenital tracts: *Giardia lamblia, Dientamoeba fragilis, Chilomastix mesnili, Trichomonas.* Blood and tissue flagellates: *Leishmania, Trypanosoma* . Apicomplexes and microsporidia: *Plasmodium, Babesia, Toxoplasma gondii, Cryptosporydium, Cyclosporidia, Isospora belii, Sarcocystis, Microsporidia* . | Antiparasitic drugs. Mechanisms of action of antiparasitic drugs, Diagnostics and prevention of protozoal infections. |

UNIT 14 (WEEK FOURTEEN): **HELMINTHS**

| **Theoretical classes: 3** | **Practical classes: 3** |
|---|---|
| Intestinal and tissue nematodes: *Ascaris lumbricoides, Trichuris trichiura, Enterobius vermicularis, Ancylostoma duodenale, Necator americanus, Strongyloides stercoralis, Trichinela spiralis, Toxocara canis/cati, Wuchereria bancrofti, Brugia malayi/timori, Loa loa, Onchocerca volvulus, Dracunculus medinensis.* Intestinal and tissue cestodes: *Taenia solium, Taenia saginata, Hymenolepis nana, Diphylobotridium latum, Echinococcus granulosus.* Trematodes: *Fasciola hepatica, Fasciolopsis buski, Dicrocoelium lancelatum, Clonorchis sinensis, Paragonimus westermani, Shistosoma* | Antiparasitic drugs. Mechanisms of action of antiparasitic drugs, Diagnosis and prevention of infections/infestations caused by helminths. |

UNIT 15 (WEEK FIFTEEN): **FUNGI**

| **Theoretical classes: 3** | **Practical classes: 3** |
| --- | --- |
| Opportunistic fungi: Yeasts: *Candida, Cryptococcus, Rhodotorula, Pneumocystis; Molds: Aspergillus, Penicillium, Mucor, Rhizopus, Rhizomucor.* Pathogenic fungi*: Dermatophytes: Trichophyton, Microsporum, Epidermophyton;* Dimorphic fungi*: Sporothrix schenckii, Histoplasma capsulatum, Blastomyces dermatitidis, Paracoccidioides brasiliensis, Coccidioides immitis.* | Antifungals. Mechanisms of action of the antifungal. Diagnosis and prevention of fungal infections. |

# SCHEDULE OF CLASSES FOR MICROBIOLOGY

| Week | Type | Topic Title | Lecturer |
|---|---|---|---|
| 1 | T | Basic characteristics of the bacterial cell. | Dejan Baskić<br>Sanja Matic |
| | P | Introduction to work in a microbiological laboratory. Safety and levels of protection in a microbiological laboratory. Types and handling of samples for microbiological analysis. Types of microscopes and microscopy techniques. Culture media used in microbiology. Gram staining. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 2 | T | Infection, pathogenicity, virulence and diagnostics. | Dejan Baskić<br>Sanja Matic |
| | P | Virulence factors and bacterial toxins. Mechanisms of action of bacterial toxins. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 3 | T | Prevention and treatment of infectious diseases. | Dejan Baskić<br>Sanja Matic |
| | P | Asepsis, antisepsis, sterilization, disinfection, resistance testing, antibiogram. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 4 | T | Pathogens responsible for pyogenic infections. Gram-positive and gram-negative cocci and bacilli. | Dejan Baskić<br>Sanja Matic |
| | P | Microbiological approach to diagnosing infectious diseases. Diagnosis and prevention of pyogenic infections. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 5 | T | Pathogens responsible for diarrhoeal syndromes. Enterobacteriaceae and other gram-negative bacilli. | Dejan Baskić<br>Sanja Matic |
| | P | Introduction to the immunological approach in diagnosing infectious diseases. Diagnosis and prevention of bacterial diarrheal syndromes. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 6 | T | Pathogens responsible for tuberculosis, leprosy and diphtheria. Anaerobic and sporogenic bacteria. | Dejan Baskić<br>Sanja Matic |
| | P | Diagnosis and prevention of infections caused by mycobacteria, anaerobic, and spore-forming bacteria. Ziehl-Neelsen staining. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 7 | T | Pathogens responsible for zoonoses and sexually transmitted diseases. Spiral and obligate intracellular bacteria | Dejan Baskić<br>Sanja Matic |
| | P | Immunological approach in diagnosing infectious diseases: ELISA and western blot. Diagnosis and prevention of bacterial zoonoses and sexually transmitted infections. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |

| Week | Type | Topic Title | Lecturer |
|---|---|---|---|
| 8 | T | Basics of the virology. | Dejan Baskić<br>Sanja Matic |
| | P | Antiviral drugs. The mechanism of action of antiviral drugs. Interferons. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 9 | T | Viruses important for the development of infections of the central nervous system and respiratory tract. | Dejan Baskić<br>Sanja Matic |
| | P | Molecular-biological approach in the diagnosis of infectious diseases. Polymerase chain reaction. Sequencing. Diagnosis and prevention of CNS and respiratory viral infections. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 10 | T | Viruses important for the development of diarrhoeal syndrome arboviruses, zoonoses and oncogenic viruses. | Dejan Baskić<br>Sanja Matic |
| | P | Diagnostics and prevention of viral diarrheal syndromes, arbovirus and zoonotic infections. Diagnostics of HPV infection, prevention and importance in the occurrence of cervical cancer. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 11 | T | Herpes viruses and other viruses responsible for rash fever. | Dejan Baskić<br>Sanja Matic |
| | P | Diagnosis and prevention of herpes virus infections and other triggers of rash fever. TORCH. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 12 | T | Hepatitis viruses. Retroviruses and prions. | Dejan Baskić<br>Sanja Matic |
| | P | Diagnosis and prevention of viral hepatitis and retroviral infections. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 13 | T | Protozoa. | Dejan Baskić<br>Sanja Matic |
| | P | Antiparasitic drugs. Mechanisms of action of antiparasitic drugs, Diagnostics and prevention of protozoal infections. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 14 | T | Helminths. | Dejan Baskić<br>Sanja Matic |
| | P | Antiparasitic drugs. Mechanisms of action of antiparasitic drugs, Diagnosis and prevention of infections/infestations caused by helminths. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |
| 15 | T | Fungi | Dejan Baskić<br>Sanja Matic |

| Week | Type | Topic Title | Lecturer |
|---|---|---|---|
| | **P** | Antifungals. Mechanisms of action of the antifungal. Diagnosis and prevention of fungal infections. | Dejan Baskić<br>Sanja Matić<br>Milica Stojković<br>Tijana Marković<br>Ana Todorović |