MICROBIOLOGY AND IMMUNOLOGY

SECOND YEAR

2023/2024.

Subject:

MICROBIOLOGY AND IMMUNOLOGY

The course is evaluated with 12 ECTS. There are 11 hours of active teaching per week (6 hours of lectures and 5 hours of work in a small group).

Teachers:

N	name	email	title
1.	Ivan Jovanovic	ivanjovanovic77@gmail.com	Full professor
2.	Gordana Radosavljevic	perun.gr@gmail.com	Full professor
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11.	Isidora Stanisavljevic	isidorastanisavljevic97@gmail.com	Junior teaching assistant

COURSE STRUCTURE :

Module	Name of the module	Week	Lectures weekly	Work in a small group per week	Teacher-leader of the module
1	Immunology	6	6	5	Prof. dr Ivan Jovanovic
2	Bacteriology	4	6	5	
3	Virology and Parasitology	5	6	5	
Σ90+75=165					

EVALUATION:

The grade is equivalent to the number of aerned points (maximum 100). Points are earned in two ways: through pre-exam activities and final exam:

PRE-EXAM ACTIVITIES: In this way, the student can earn up to 30 points by actively participating in small group and answering questions related to this week's lesson. Based on demonstrated knowledge, the student can earn between 0-2 points per week.To pass the module, student needs to acquire more than 50% of the total points for that module (see table). Part of the practical teaching will be performed in the laboratories of the Center for Molecular Medicine and Stem Cell Research, FMS Kragujevac. Students who do not earn more than 50% of the points in pre-exam activity will take the exam by answering 2 questions from each module that they have not passed.

MODULE		**MAXIMUM POINTS**
		Activity during work in a small group
1	Immunology	12
2	Bacteriology	8
3	Virology and Parasitology	10
	Σ	30

FINAL EXAM: In this way, student can earn up to 70 points. Student takes the test which includes 70 questions that are covering the entire subject material. If the student does not achieve more than 50% correct answers, he/she has not passed the final exam.

The final grade is formed as follows:

In order to pass the course, the student must obtain a minimum of 51 points, pass pre-exam activities on all modules and pass the final exam (test).

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

LITERATURE:

module	the name of the textbook	authors	publisher	the library
Immunology	*Basic Immunology: Functions and Disorders of the Immune System, 6th edition.*	Abul K.Abbas and Andrew H. Lichtman	Elsevier, Philadelphia 2019.	
Bacteriology	*Schaechter's Mechanisms of Microbial Disease*	N. Cary Engleberg	Walters Kluwer, 2012	
Virology	*Schaechter's Mechanisms of Microbial Disease Sixth edition*	N. Cary Engleberg	Walters Kluwer, 2021	
Parasitology				
Additional literature	*Medical Microbiology*	Ernest. Jawetz, Joyeph Melnick, Edward Adelberg:	Appleton & Lange, 1998.	
	Antimicrobial nanoarchitectonics, First edition	Alexandru Grumezescu	*Elsevier* 2017. ISBN: 978032527330	

PowerPoint presentations of lectures and handouts are available on the website of the Faculty of Medical Sciences: **www.medf.kg.ac.rs**

PROGRAM:

FIRST MODULE: IMMUNOLOGY

TEACHING UNIT 1 (FIRST WEEK)

INTRODUCTION TO THE IMMUNE SYSTEM

3 hours lecture

Concepts, dictionary.
Innate and acquired immunity.
Types of acquired immunity.
Properties of acquired immune response: specificity and diversity, memory.
Cells of the immune system: lymphocytes, antigen-presenting cells, effector cells.
Tissues of the immune system: peripheral lymphoid organs, lymphocyte recirculation and migration to tissues.

INNATE IMMUNITY

3 hours lecture

General properties and specificity of the innate immune response.
Cell receptors for microorganisms and damaged cells: Toll-like receptors, NOD-like receptors, and inflammasom.
Components of innate immunity: epithelial barriers, phagocytes, dendritic cells, mast cells, NK cells, complement system, cytokines of innate immunity.
Reactions of innate immunity: inflammation, antiviral defense.
How microorganisms evade innate immunity.
The role of innate immunity in stimulating acquired immune response..

TEACHING UNIT 2 (SECOND WEEK)

ANTIGEN CAPTURE AND PRESENTATION TO LYMPHOCYTES

3 hours lecture

What do T lymphocytes see?
Antigens recognized by T lymphocytes.
How antigen-presenting cells capture protein antigens.
Structure and function of major histocompatibility complex (MHC) molecules.
Properties of MHC genes and proteins.
Binding of peptides to MHC molecules.
Processing and presentation of protein antigens in the context of MHC class I.
Processing and presentation of protein antigens in the context of MHC class II.
Cross-presentation of internalized antigens to CD8+ T lymphocytes.
Physiological significance of antigen presentation in the context of MHC molecules.
Other functions of antigen-presenting cells.
Antigens recognized by B lymphocytes.

RECOGNITION OF ANTIGENS IN ACQUIRED IMMUNITY

3 hours lecture

Antigen receptors of B and T lymphocytes.
Antibodies; antibody classes; monoclonal antibodies.
TCR (T cell receptor).
Development of the immune repertoire.
Early maturation of lymphocytes.
Formation of different antigen receptors.
Maturation and selection of B lymphocytes.
Maturation and selection of T lymphocytes.

TEACHING UNIT 3 (THIRD WEEK)

CELLULAR IMMUNE RESPONSE

3 hours lecture

Phases of T-cell response.
Antigen recognition and costimulation.
Recognition of peptides within MHC molecules.
Role of adhesion molecules in T-cell response.
Role of costimulation in T-cell activation.
Stimulatory signals for activation of CD8+ T cells.
Biochemical pathways of T-cell activation.
Functional response of T cells to antigen and costimulation.
Cytokine secretion and expression of cytokine receptors.
Clonal expansion.
Differentiation of naïve T cells into effector cells.
Generation of memory T cells.
Weakening of the immune response.

EFFECTOR MECHANISMS OF CELLULAR IMMUNITY

3 hours lecture

Types of cellular immune reactions.
Migration of effector T cells in cellular immune reactions.
Effector functions of CD4+ helper T cells.
Role of Th1, Th2, and Th17 cells in organism defense.
Pathogenesis of tuberculosis and leprosy.
Effector functions of CD8+ cytotoxic T cells.
Resistance of pathogens to cellular immune mechanisms.

TEACHING UNIT 4 (FOURTH WEEK)

HUMORAL IMMUNE RESPONSE

3 hours lecture

Phases and types of humoral immune response.
Stimulation of B cells by antigen.
Antigen-induced signal transduction in B cells.
Role of complement proteins and other signals in innate immunity in B cell activation.
Functional consequences of B cell activation.
Function of helper T cells in humoral immune response to protein antigens.
Activation and migration of helper T cells.
How B cells present antigens to helper T cells.
Mechanisms of B cell activation mediated by helper T cells.
Reactions occurring outside follicles and in germinal centers.
Antibody class switching.
Affinity maturation.
Humoral response to T-independent antigens.
Regulation of humoral immune response: feedback regulation by antibodies.

EFFECTOR MECHANISMS OF HUMORAL IMMUNITY

3 hours lecture

Properties of antibodies determining their effector function.
Neutralization of microorganisms and their toxins.
Opsonization and phagocytosis.
Antibody-dependent cellular cytotoxicity (ADCC).
IgE and reactions mediated by mast cells and eosinophils.

Complement system: activation pathways, functions, and regulation.
Functions of antibodies at specific anatomical sites.
Mucosal immunity.
Neonatal immunity.
How microorganisms evade humoral immunity.

TEACHING UNIT 5 (FIFTH WEEK)

IMMUNE TOLERANCE AND AUTOIMMUNITY

3 hours lecture

Immune tolerance, significance, and mechanisms.
Central tolerance of T cells.
Peripheral tolerance of T cells: anergy, immune suppression mediated by regulatory T cells, deletion, apoptosis of mature lymphocytes.
Tolerance of B cells: Central tolerance of B cells, Peripheral tolerance of B cells.
Autoimmunity: pathogenesis, genetic factors, the role of infections, and the influence of other environmental factors.

HYPERSENSITIVITY

3 hours lecture

Types of hypersensitivity reactions.
Immediate hypersensitivity (Type I hypersensitivity): activation of Th2 lymphocytes and IgE antibody production, mast cell activation and mediator release, clinical syndromes, and therapy.
Diseases caused by antibodies and antigen-antibody complexes: etiology of antibody-mediated diseases, mechanisms of tissue damage and diseases, clinical syndromes, and therapy.
Diseases caused by T lymphocytes: etiology of T cell-mediated diseases, mechanisms of tissue damage, clinical syndromes, and therapy.

TEACHING UNIT 6 (SIXTH WEEK)

IMMUNE RESPONSE TO TRANSPLANTED TISSUES

1 hour lecture

Immune response to transplanted tissues: transplant antigens, induction of immune response against grafts, immune mechanisms of graft rejection.
Prevention and therapy of graft rejection.
Transplantation of blood cells and hematopoietic stem cells.
Tolerance of the mother to fetal tissues.

CONGENITAL IMMUNODEFICIENCIES

3 hours lecture

Concept of immunodeficiency.
Innate and acquired immunodeficiencies (genetic defects, malnutrition, infections).
Disorders of nonspecific immunity (barriers, phagocyte functions, complement component deficiencies).
Disorders of specific cellular and humoral immune response.

SEPSIS AND SEPTIC SHOCK

2 hours lecture

Concept of systemic inflammatory response and multiple organ dysfunction as a consequence of infection.
Etiology and pathogenesis of sepsis and septic shock.
Inflammatory mediators and regulatory cytokines in sepsis and shock, major tissue damage.
Treatment of sepsis and septic shock.

SECOND MODULE: BACTERIOLOGY

TEACHING UNIT 7 (SEVENTH WEEK)

BACTERIAL CELL BIOLOGY

2 hours lecture

Establishment of Infection. Infection. Pathogenicity. Virulence.
Colonization, microorganism penetration, microorganism survival in a new environment, spread, and reproduction.
Finding a compatible nutrient niche.
Avoidance of immune response.
Mechanisms of tissue damage.
Microorganism prevalence. Ecological associations.
Normal microflora: definition of normal microflora, the significance of normal microflora for hosts, bacteria comprising the majority of normal microflora.

BACTERIAL CELL BIOLOGY

2 hours lecture

Prokaryotic and Eukaryotic cells. Specifics of the structure of G+ and G- bacterial cell walls. Acid-resistant bacteria.
Capsule, flagella, pili, adhesion, and chemotaxis of bacterial cells. Peptidoglycan.
Cytoplasmic membrane (functions, transport, siderophores).
Bacterial DNA (specifics of bacterial chromosome structure, replication, transcription).
Exchange of genetic material, conjugation, transformation, transduction. Ribosomes.
Specifics of protein synthesis in bacteria. Spores.
Conditions for bacterial growth and reproduction: Temperature, oxygen, and carbon dioxide, growth curve.
Bacterial metabolism, regulation of metabolism.
Tissue damage by microorganism toxins; exotoxins, endotoxin, superantigens, extracellular matrix-acting Enzymes.

BACTERIAL CELL BIOLOGY

2 hours lecture

Definition of zoonoses. Transmission routes of zoonoses.
Antibiotics.
What is the basis of selective antibiotic action?
Mechanisms of antibiotic action.
Antibiogram.
Mechanisms of bacterial resistance to antibiotics.
Sterilization and disinfection.

TEACHING UNIT 8 (EIGHTH WEEK)

GRAM-POSITIVE AND GRAM-NEGATIVE COCCI

3 hours lecture

Staphylococcus: Pyogenic infections and toxin-mediated diseases.
Characteristics, natural habitat, transmission, and survival in a new environment of *Staphylococcus aureus*.
Virulence factors and mechanism of tissue damage caused by *Staphylococcus aureus* and *Staphylococcus epidermidis*.
Diseases caused by *Staphylococcal* toxins.
Diagnosis, treatment, and prevention of *Staphylococcal* diseases.
Streptococcus, Enterococcus.
Classification of *Streptococci*.
Characteristics, natural habitat, transmission, and survival in a new environment, virulence factors, and mechanism of tissue damage caused by Group A *Streptococcus*.

Toxins of Group A *Streptococci*.
Diseases caused by the immune response to Group A *Streptococcus*.
treatment and prevention of diseases caused by Group A *Streptococcus*.
Group B *Streptococci*, characteristics, natural habitat, virulence factors, diseases caused by Group B *Streptococci*.
Enterococci.
Pneumococcus, bacterial pneumonia.
Characteristics and natural habitat of *Streptococcus pneumoniae*.
Diseases caused by *Streptococcus pneumoniae*, virulence factors, mechanism of tissue damage, characteristics of pneumonia caused by this bacterium.
Diagnosis, treatment, and prevention of diseases caused by *Pneumococcus*.
Gram-Negative cocci, *Neisseriae*. Characteristics, natural habitat, transmission, colonization, spread, virulence factors, and mechanism of tissue damage caused by *Neisseria gonorrhoeae*.
meningococcal infections.

HAEMOPHILUS AND OTHER FASTIDIOUS GRAM-NEGATIVE BACILLI

3 hours lecture

Bordetella pertussis and *parapertussis*, whooping cough:
Characteristics, natural habitat, mode of transmission, colonization, spread, virulence factors, tissue damage mechanisms, diagnosis, treatment, and prevention of diseases caused by *Bordetella pertussis* and *V. parapertussis.*
Legionella, intracellular parasite:
Characteristics, natural habitat, mode of transmission, colonization, spread, virulence factors, tissue damage mechanisms, diagnosis, treatment, and prevention of diseases caused by the bacterium *Legionella pneumophila*.
Haemophilus influenzae:
Characteristics, natural habitat, mode of transmission, colonization, spread, virulence factors, tissue damage mechanisms, diagnosis, treatment, and prevention of diseases.

TEACHING UNIT 9 (NINTH WEEK)

ENTERIC BACTERIA CAUSING SECRETORY DIARRHEA

2 hours lecture

Enterobacteriaceae, Vibrionaceae.
Characteristics, natural habitat, transmission, colonization, and spread of bacteria causing secretory diarrhea.
Virulence factors and mechanism by which *V. cholerae* induces diarrhea, Enterotoxigenic and Enteropathogenic *E. coli*. Other diseases caused by *V. cholerae* and *E. coli.*
Diagnosis, treatment, and prevention.

INVASIVE GASTROINTESTINAL INFECTIONS

2 hours lecture

Characteristics, natural habitat, transmission, colonization, spread, virulence factors, and mechanism of tissue damage caused by *Shigella* bacteria.
Diagnosis, treatment, and prevention of diseases caused by *Shigella* bacteria.
Characteristics, natural habitat, transmission, colonization, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of hemorrhagic colitis caused by enterohemorrhagic *E. coli.*
Clinical syndromes caused by bacteria of the *Salmonella* genus.
Characteristics, natural habitat, transmission, colonization, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of hemorrhagic colitis caused by *Salmonella* bacteria. *Helicobacter pylori*, persistent bacterial infection.
Characteristics, natural habitat, transmission, colonization, spread, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by *Helicobacter pylori.*

NON-INVASIVE GASTROINTESTINAL AND INTRA-ABDOMINAL INFECTIONS

1 hour lecture

Pseudomonas aeruginosa, ubiquitous opportunist.
Characteristics, natural habitat, transmission, colonization, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by *Pseudomonas aeruginosa.*
Bacteroides, intra-abdominal infections, and abscesses.
Characteristics, natural habitat, transmission, colonization, spread, virulence factors, and mechanism of tissue damage caused by bacteria of the *Bacteroid*es genus.
Diagnosis, treatment, and prevention of diseases caused by *Bacteroides* bacteria.

ZOONOSES

1 hour lecture

Brucella spp.
Characteristics, natural habitat, transmission, colonization, spread, virulence factors, and mechanism of tissue damage.
Leptospira spp.
Characteristics, natural habitat, transmission, colonization, spread, virulence factors, and mechanism of tissue damage.

TEACHING UNIT 10 (TENTH WEEK)

ANAEROBIC GRAM-POSITIVE BACTERIA

2 hours lecture

Clostridia: diarrhea, tissue infections, botulism, and tetanus
Clostridium difficile (diarrhea): characteristics, natural habitat, transmission, colonization, spread, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention.
Clostridium perfringens (tissue infections): characteristics, natural habitat, transmission, colonization, spread, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention.
Clostridium botulinum (botulism): characteristics, natural habitat, transmission, virulence factors, mechanism of disease induction, diagnosis, treatment, and prevention.
Clostridium tetani (tetanus): characteristics, natural habitat, transmission, virulence factors, mechanism of disease induction, diagnosis, treatment, and prevention.

MYCOBACTERIA

2 hours lecture

Mycobacterium tuberculosis: Specific characteristics. Natural habitat, transmission, colonization, spread, and mechanism of tissue damage. Immune response to mycobacteria.
Primary, post-primary, and secondary tuberculosis. Diagnosis, treatment, and prevention.
Tuberculin test.
Mycobacterium leprae: Characteristics, transmission, mechanism of tissue damage. Tuberculoid and lepromatous leprosy.
Potential biological weapons: anthrax, plague, tularemia, botulism.
Corynebacterium diphtheriae: Cat scratch disease, *Bartonella henselae.*

SPIRAL BACTERIA

1 hour lecture

Treponema pallidum: Characteristics, natural habitat, transmission, colonization, spread, virulence factors, mechanism of tissue damage in diseases caused by Treponema pallidum.
Primary, secondary, tertiary, congenital syphilis.
Diagnosis, treatment, and prevention of syphilis.
Borrelia burgdorferi, Lyme disease: Characteristics, natural habitat, transmission, colonization, spread, virulence factors, mechanism of tissue damage in diseases caused by *Borrelia burgdorferi*.
Three stages of Lyme disease. Diagnosis, treatment, and prevention of Lyme disease..

INTRACELLULAR BACTERIA

1 hour lecture

Chlamydiae: Genital, ocular, and respiratory infections.Classification and biology of chlamydiae. Characteristics, natural habitat, transmission, colonization, spread, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by *Chlamydia trachomatis, C. pneumoniae, C. psittaci.*

Rickettsiae: Characteristics, natural habitat, transmission, colonization, spread, virulence factors mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by bacteria*: Rickettsia rickettsii* (Rocky Mountain spotted fever), *Rickettsia prowazekii* (epidemic typhus).

Mycoplasma: Characteristics of mycoplasmas and ureaplasmas.

Natural habitat, transmission,
colonization, spread, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by *Mycoplasma pneumoniae*.

Natural habitat, transmission,
colonization, spread, virulence factors, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by genital mycoplasmas.

THIRD MODULE: PARASITOLOGY AND VIROLOGY

TEACHING UNIT 11 (ELEVENTH WEEK)

INTRODUCTION TO PARASITOLOGY

1 hour lecture

Introduction to parasitology.
Relationship between infection and disease.
Types of parasites and modes of transmission (protozoa, helminths, vectors, reservoirs).
Establishment of parasitic infection: entry, spread and multiplication, mechanism of tissue damage/disease, diagnosis.
Treatment and prevention of parasitic diseases.

PROTOZOA AND INSECTS

3 hours lecture

Blood and tissue protozoa.
Parasites of red blood cells (*Plasmodium*): characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.
Tissue protozoa: *Toxoplasma gondii, Leishmania species, Trypanosoma* species.
Characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.
Intestinal protozoa: *Entamoeba histolytica, Giardia lamblia, Cryptosporidium, Trichomonas vaginalis.*
Characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.
Cyclospora, Isospora, Microsporidia. Sarcoptes scabiei, lice, fleas, mosquitoes, ticks.

HELMINTHS

2 hours lecture

Intestinal helminths.
Nematodes, trematodes, cestodes: characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.
Blood and tissue helminths.*Trichinella spiralis, Schistosoma* (*mansoni, japonicum, haematobium),*
Filariae: characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.

TEACHING UNIT 12 (TWELFTH WEEK)

INTRODUCTION TO MYCOLOGY

2 hours lecture

Introduction to mycology, fungi, and mycoses.
Pathogenic fungi: characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.
Antifungal drugs.

MYCOSES

4 hours lecture

Endemic mycoses.
Histoplasmosis, Coccidioidomycosis, Blastomycosis: characteristics, transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.

Opportunistic fungal infections.
Characteristics of the causative agents of candidiasis,
cryptococcosis, aspergillosis, mucormycosis, and pneumocystosis; modes of transmission, spread and multiplication, mechanisms by which they induce tissue damage, diagnosis of infection, treatment, and prevention.
Subcutaneous, cutaneous, and superficial mycoses.
Sporotrichosis (subcutaneous mycosis).
Dermatophytes (cutaneous mycoses).
Seborrhea, Tinea versicolor (superficial mycoses).

TEACHING UNIT 13 (THIRTHEENTH WEEK)

VIROLOGY

2 hours lecture

Structure and classification of viruses.
Virus replication (adsorption and penetration, synthesis of viral macromolecules, virion assembly, and release from the cell).
Relationship between viruses and cells, types of viral infections.
Routes of virus entry into the host organism and spread throughout the organism.
Mechanisms of tissue damage in viral infections.
Diagnosis of viral diseases.
Antiviral drugs.

PICORNAVIRUSES, CORONAVIRUSES, AND ADENOVIRUSES

2 hours lecture

Picornaviruses and coronaviruses. Characteristics of viruses, transmission, colonization, spread, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by enteroviruses (*Poliovirus*).
Diseases caused by other enteroviruses.
Characteristics of viruses, transmission, colonization, spread, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by rhinoviruses.
Coronaviruses, SARS.
Viruses causing gastroenteritis: *Rotavirus*, *Norovirus* transmission, colonization, spread, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by *Rotavirus.*
Transmission, colonization, spread, mechanism of disease, diagnosis, treatment, and prevention of diseases caused by *Norovirus* (Norwalk virus).
Adenoviruses Characteristics, transmission, colonization, spread, adenovirus replication.
Pathogenesis of diseases caused by adenoviruses, prevention, and treatment.

ORTHOMYXOVIRUSES, PARAMYXOVIRUSES, RASH FEVERS

2 hours lecture

Paramyxoviruses: Morbili virus, Respiratory syncytial virus RSV
Characteristics of paramyxoviruses.
Transmission, colonization, spread, mechanism of tissue damage by the measles virus.
Complications, diagnosis, treatment, and prevention of measles.
Mumpsvirus.
Transmission, colonization, spread, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by the RSV virus.
Variolavirus.
Rubivirus Influenza virus: Characteristics of the virus, transmission, colonization, spread, mechanism of tissue damage, diagnosis, treatment, and prevention of diseases caused by the influenza virus.

TEACHING UNIT 14 (FOURTEENTH WEEK)

HERPESVIRUSES, PAPILLOMAVIRUSES

3 hours lecture

Alphaherpesvirinae; Herpes simplex virus, Varicella-Zoster virus: Characteristics, transmission, colonization, replication, spread, pathogenesis, prevention, and treatment of diseases.
Immune response to herpes virus infections.
Beta and Gama-herpesvirinae; *Cytomegalovirus, Epstein-Barr virus* Transmission, colonization, mechanisms inducing tissue damage, diagnosis, infection, treatment, and prevention.
Replication characteristics of the virus, persistent and latent infections.
Clinical syndromes, infections in immunodeficient individuals, oncogenic potential.
Papillomaviridae
Characteristics, transmission, colonization, spread, pathogenesis, prevention, and treatment of diseases caused by papillomaviruses.

RABIES VIRUS

1 hour lecture

Rabies virus, rabies
Characteristics of the rabies virus, transmission, colonization, spread, mechanism of tissue damage, diagnosis, treatment, and prevention of rabies.

HEPATITIS VIRUSES, PRION DISEASES

2 hours lecture

Viral hepatitis
The liver as a site for virus replication.
Characteristics of infections caused by hepatitis viruses.
HAV, HBV, HCV, HDV, HEV.
Prion diseases Creutzfeldt-Jakob disease.
Mad cow disease.
Gerstmann-Straussler-Scheinker syndrome.
Fatal familial insomnia.

TEACHING UNIT 15 (FIFTEENTH WEEK)

ARBOVIRUSES AND VIRUSES CAUSING HEMORRHAGIC FEVERS

1 hour lecture

Arboviruses transmitted by arthropods, West Nile virus, Eastern equine encephalitis virus, St. Louis encephalitis virus, Dengue virus, Crimean-Congo hemorrhagic fever virus.
Diseases caused by arboviruses (encephalitis, rash, arthritis, and hemorrhagic fever).
Hemorrhagic fever viruses transmitted by direct contact with an infected person: *Ebolavirus, Marburgvirus, Lassavirus.*

PATHOGENIC HUMAN RETROVIRUSES, REVERSE TRANSCRIPTASE, HISTORY OF RETROVIROLOGY

3 hours lecture

Human immunodeficiency viruses (HIV)
Life cycle, antigenic variations, molecular basis of HIV infection.
Principles of diagnostic tests for HIV infection.
Mechanisms of immune reactivity damage by HIV infection.

Acquired immunodeficiency syndrome (AIDS).
Opportunistic infections as diagnostic signs of AIDS.
Infections defining the AIDS stage in HIV-positive individuals (respiratory, gastrointestinal, and central nervous system infections, fungi, mycobacteria).
Oncological consequences of AIDS.
Genetic and developmental predispositions to AIDS, neonatal AIDS, the significance of co-receptors), principles of treatment (including antiviral drug resistance and pharmacogenetics).
Prevention of HIV infection.

VACCINES
2 hours lecture
Concept of immunization and vaccination

WEEKLY COURSE SCHEDULE

COURSE	MONDAY
MICROBIOLOGY AND IMMUNOLOGY (6+5)	**LECTURES** **09:00 - 11:15** Physiological practice room (R31) **PRACTICE** **11:30 -13:45** Physiological practice room (R31)

LESSON SCHEDULE FOR THE SUBJECT MICROBIOLOGY AND IMMUNOLOGY

module	week	date	time	place	type	method unit name	Teacher
1	1			**C1**	**L**	**Introduction to the immune system.** **Innate immunity.**	**Prof. dr Ivan Jovanovic**
				C35, C37 **C39, C41**	**P**		Prof. dr Ivan Jovanovic Dr Isidora Stanisavljevic
	2			**C1**	**L**	**Antigen capture and presentation to lymphocytes.** **Recognition of antigens in acquired immunity.**	**Prof. dr Marija Milovanovic**
				C35, C37 **C39, C41**	**P**		Prof. dr Marija Milovanovic Dr Vladimir Markovic
	3			**C1**	**L**	**Cellular immune response.** **Effector mechanisms of cellular immunity.**	**Prof. dr Gordana Radosavljevic**
				C35, C37 **C39, C41**	**P**		Prof. dr Gordana Radosavljevic Dr Andjela Petrovic
	4			**C1**	**L**	**Humoral immune response.** **Effector mechanisms of humoral immunity.**	**Prof. dr Vladislav Volarevic**
				C35, C37 **C39, C41**	**P**		Dr Andjela Petrovic Prof. dr Vladislav Volarevic
	5			**C1**	**L**	**Immune tolerance and autoimmunity.** **Hypersensitivity.**	**Assoc. prof. dr Jelena Pantic**

LESSON SCHEDULE FOR THE SUBJECT MICROBIOLOGY AND IMMUNOLOGY

module	week	date	time	place	type	method unit name	Teacher
				C35, C37 C39, C41	**P**		Assoc. prof. dr Jelena Pantic Dr Vladimir Markovic
	6			**C1**	**L**	**Immune response to translated tissues. Congenital immunodeficiencies. Sepsis and septic shock.**	**Assis. prof. dr Nevena Gajovic**
				C35, C37 C39, C41	**P**		Assis. prof. dr Nevena Gajovic Dr Isidora Stanisavljevic
2	7			**C1**	**L**	**Bacterial cell biology. Normal microflora. Establishment of infection. Antibiotics. Sterilization and disinfection.**	**Prof. dr Vladislav Volarevic**
				C35, C37 C39, C41	**P**		Dr Vladimir Markovic Prof. dr Vladislav Volarevic
	8			**C1**	**L**	**Gram-Positive Cocci. Gram-Negative Cocci. Haemophilus and other fastidious Gram-negative bacilli.**	**Assoc. prof. dr Sladjana Pavlovic**
				C35, C37 C39, C41	**P**		Assoc. prof. dr Sladjana Pavlovic Dr Isidora Stanisavljevic
	9			**C1**	**L**	**Enteric bacteria causing secretory diarrhea. Invasive gastrointestinal infections.**	**Assoc. prof. dr Sladjana Pavlovic**

LESSON SCHEDULE FOR THE SUBJECT MICROBIOLOGY AND IMMUNOLOGY

module	week	date	time	place	type	method unit name	Teacher
				C35, C37 C39, C41	**P**	**Non-invasive gastrointestinal and intra-abdominal infections. Zoonoses.**	Dr Andjela Petrovic Assoc. prof. dr Sladjana Pavlovic
	10			**C1**	**L**	**Anaerobic G+ bacteria. Mycobacteria. Spiral bacteria. Intracllular bacteria.**	**Prof. dr Gordana Radosavljevic**
				C35, C37 C39, C41	**P**		Dr Vladimir Markovic Prof. dr Gordana Radosavljevic
3	11			**C1**	**L**	**Introduction to parasitology. Protozoa and insects. Helminths.**	**Prof. dr Ivan Jovanovic**
				C35, C37 C39, C41	**P**		Dr Isidora Stanisavljevic Prof. dr Ivan Jovanovic
	12			**C1**	**L**	**Introduction to mycology. Mycoses.**	**Assoc. prof. dr Jelena Pantic**
				C35, C37 C39, C41	**P**		Dr Andjela Petrovic Assoc. prof. dr Jelena Pantic
	13			**C1**	**L**	**Virology. Picornaviruses, coronaviruses, and adenoviruses. Orthomyxoviruses, paramyxoviruses, rash fevers.**	**Prof. dr Ivan Jovanovic**
				C35, C37 C39, C41	**P**		Dr Isidora Stanisavljevic Prof. dr Ivan Jovanovic
	14			**C1**	**L**	**Herpesviruses, papillomaviruses. Rabies virus.**	**Prof. dr Marija Milovanovic**

LESSON SCHEDULE FOR THE SUBJECT MICROBIOLOGY AND IMMUNOLOGY

module	week	date	time	place	type	method unit name	Teacher
				C35, C37 C39, C41	**P**	**Hepatitis viruses, prion diseases.**	Dr Vladimir Markovic Prof. dr Marija Milovanovic
	15			**C1**	**L**	**Arboviruses and viruses causing hemorragic fevers. Pathogenic human retroviruses, reverse transcriptase, history of retrovirology. Acquired immunodeficiencies.**	**Assis. prof. dr Nevena Gajovic**
				C35, C37 C39, C41	**P**		Dr Andjela Petrovic Assis. prof. dr Nevena Gajovic
					E	**FINAL EXAM**	