[Medicinski fakultet u Rijeci]

Curriculum
2023/2024

[Za kolegij]

Immunology

Study program:	**Medical Studies in English (R)** [Sveučilišni integrirani prijediplomski i diplomski studij]
Department:	**[Katedra za fiziologiju, imunologiju i patofiziologiju]**
Course coordinator:	**prof. dr. sc. Lučin Pero, dr. med.**
Year of study:	**2**
ECTS:	**4**
Incentive ECTS:	**0 (0.00%)**
Foreign language:	**Possibility of teaching in a foreign language**

Course information:

The main aim of this course is to introduce students to the normal and pathological function of the immune system. The focus is on the explanation of physiological processes that enable normal functioning of certain subtypes of immune cells in a non-specific and specific immune response, as well as on the explanation of pathophysiological mechanisms leading to disorders of normal immune processes, as well as on the possibilities for therapeutic action to the immune response. Teaching tasks imply enabling the student to connect basic knowledge of immunology and pathophysiology of the immune system with the teaching of physiology and pathophysiology, microbiology and parasitology, pathology, infectious disease, oncology, and epidemiology (vaccination), therefore, qualifying the student to apply immunological cognition in clinical medicine.

Course content:

Overview of Immunity. Antigens. Tissue Cells and Organs of the Immune System. Major Histocompatibility Complex Molecules. Immune Recognition. Cellular Immunity. Non-specific Immunity. Complement. Structure of Antibody and Antigen Receptor of Lymphocyte B. Gene Background of Synthesis and Antibody Differences. Humoral Immunity. Immune Response Regulation. Interaction of Immune Cells. Action on Immune Response. Cytokines and Chemokines. Immune Response to Tumor. Immunodeficiency and AIDS. Immunotolerance and Autoimmunity. Immunity to Infections. Tissue and Organ Transplantation. Immunological Hypersensitivity. Mucosal Immunity. Vaccination. Laboratory Methods in Clinical Immunology.

Class organization:

Class attendance is mandatory. The course consists of 24 hours of lectures, 18 hours of seminars, and 8 hours of practicals, which totals 50 class hours. Students are obligated to wear lab coats during practicals and have exercise protocols, where they will write measured and obtained values. Throughout seminars and practicals, the student actively discusses immune mechanisms with the lecturer. The student is obligated to prepare the material that is being discussed in seminars and practicals. The teacher evaluates student participation throughout seminars and practicals (demonstrated knowledge, understanding, the ability to set up a problem, concluding, etc.). There will be two midterm exams during the course, and a written and an oral part of the final exam at the end of classes. After completing all class activities and the final exam, the student acquires 4 ECTS credits.

List of assigned reading:

1. Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021. **or** Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Eighth edition. Elsevier, 2015.
2. Handbook for Practicals in Immunology, Editor: H. Mahmutefendić. The University of Rijeka, Faculty of Medicine, 2014. (e-edition), 2015 (printed edition).

List of optional reading:

1. Abbas A.K, Lichtman A.H., Pillai S. Basic Immunology. Functions and Disorders of the Immune System. Fifth edition. Elsevier, 2016.
2. Murphy K, Weaver C: Janeway's Immunobiology 9th edition, Garland Science, New York and London, 2017.

Curriculum:

[Predavanja] list (with titles and explanation):

Lecture 1: Properties and Overview of Immune Responses. Cells and Tissues of the Immune System. Leukocyte Circulation and Migration into Tissues.

After the course, students should be able to:

Describe immunology as a biomedical science, the concept of immunity, immunity, immune system, and immune response. Explain the phylogenetic relationship between innate and adaptive immunity and their physiological tasks and features. List and explain the division of adaptive immunity according to the mode of acquisition and according to effector mechanisms (humoral and cellular immunity). Explain the forms of immune activity (immunoreaction, immune nonreactivity). Describe the morphological, physical, and biological properties of cells of the immune system. Describe the anatomy and function of lymphatic tissues (bone marrow, thymus, lymphatic system, lymph nodes, spleen, and regional lymphatic systems). List the subtypes of lymphocytes, basic differentiation markers on individual subsets of immune cells and describe their function. List subsets of T and B lymphocytes and describe their function. Describe the principles of migration of neutrophils, monocytes, and Ti B lymphocytes. Describe the distribution and recirculation of lymphocytes in the body. Describe the function of chemokines, chemokine receptors, and adhesion molecules on leukocytes and endothelial cells.

Learning material:

Chapter 1: Properties and Overview of Immune Responses, pages 1-12; Chapter 2: Cells and Tissues of the Immune System, pages 13-33; Chapter 3: Leukocyte Circulation and Migration into Tissues, pages 35-50. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 2: Antibodies and Antigens

After the course, students should be able to:

Describe the structure of antibodies, their heterogeneity and antigenic determinants, and the primary structure of the paratope. Understand the general laws of antigen and antibody binding, the affinity and avidness of binding molecules to recognize antigens, electrostatic forces in the reaction of antigens and antibodies. Describe the concept of antigen, antigen division, antigenic determinant (epitope) and its forms. Define the concept of immunogenicity, the factors on which antigen immunogenicity depends. Describe the principles of coupled recognition of antigens. Describe the principles of recognition of cytosolic and vesicular antigens. Describe the course of specialization of clone b lymphocytes for a certain specificity in the bone marrow.

Learning material:

Chapter 5: Antibodies and Antigens, pages 87-105. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 3: Major Histocompatibility Complex Molecules and Antigen Presentation to T Lymphocytes

After the course, students should be able to:

Understand the principles of creating a receptor repertoire of lymphocytic clones, the hypothesis of "forbidden" clones of specific immunity. Describe the mechanisms of antigen capture and the function of predominant cells. Explain the intercellular interactions of immune cells, especially predominant cells and T lymphocytes. Specify the division and explain the function of adhesion, coreceptor and co-stimulatory molecules. Describe the system of tissue antigens, their division, structure and function of MHC group I and II antigens, and distribution in the body. Understand the structure of the MHC gene (polygenia and polymorphism). Describe the role of the MHC gene in determining the characteristics of immunoreaction (in monitoring the response to individual antigens, in the occurrence of autoimmune diseases, in the occurrence of high alloreactivity). Explain the processing of foreign antigen and the mechanism of its binding to Class I and Class II MHC molecules.

Learning material:

Chapter 6: Major Histocompatibility Complex Molecules and Antigen Presentation to T Lymphocytes, pages 107-135. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 4: Immune Receptors and Signal Transduction. Activation of T Lymphocytes.

After the course, students should be able to:

Define and describe immune receptor families. Describe the structure of receptors for antigen of T lymphocytes. Understand the mechanisms of activation of T lymphocytes (transmission of signals to the cell and their effects after stimulating antigen receptor). Describe the structure of the antigen receptor on B lymphocytes, and the mechanism of transmission of the activation signal to lymphocyte B. Describe inhibitory receptors of T and B lymphocytes and NK cells. Describe the structure and division of cytokine receptors, the mechanism of signal transmission by cytokine receptors.

Learning material:

Chapter 7: Immune Receptors and Signal Transduction, pages 137-169. Chapter 9: Activation of T lymphocytes, pages 199-212. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 5: Lymphocyte Development and Antigen Receptor Gene Rearrangement

After the course, students should be able to:

Describe the structure of antigen receptors of T lymphocytes, and their heterogeneity. Describe the processes of maturation of T lymphocytes and the role of thymus in them. Describe the processes of primary and secondary maturation of B lymphocytes. Understand the multigene organization of antigen receptor genes, reshuffling mechanisms, and the assembly of functioning genes for the variable receptor region .

Learning material:

Chapter 8: Lymphocyte Development and Antigen Receptor Gene Rearrangement , pages 171.-198. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 6: Differentiation and Functions of CD4+ and CD8+ Effector T Cells

After the course, students should be able to:

Explain the mechanisms and main features of cellular immunity. Describe subsets of effector $CD4^+$ T cells. Explain macrophage activation with sensitized T lymphocytes of TH_1 subset. Explain the development and function of TH_2 subset Explain the development and function of TH_{17} lymphocyte subset. Explain the characteristics and function of Tγδ cells and NKT cells. Describe the characteristics and explain the effector roles of cytotoxic T lymphocytes and the mechanism of killing target cells.

Learning material:

Chapter 10: Differentiation and Functions of $CD4^+$ Effector T Cells, pages 213-230. Chapter 11: Differentiation and Functions of $CD8^+$ Effector T Cells, pages 231-238. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 7: B Cell Activation and Antibody Production. Effector Mechanisms of Humoral Immunity

After the course, students should be able to:

Describe the mechanisms of antigen recognition and antigenic activation of B lymphocytes. Describe the morphology of B lymphocyte differentiation, plasma cells and memory cell formation in T lymphocyte-dependent reactions. Understand the gene mechanism for switching heavy chain classes. Understand the gene mechanisms that are the source of the diversity of antibodies (creating a repertoire of antibody specificities). Understand the affinity maturation of immunoglobulins and switching IgM to IgG, and the mechanism by which a single plasma cell creates one type of immunoglobulin (allelic shutdown). Explain the kinetics of antibody formation in primary and secondary immunoreaction, distribution by body, and dynamics of antibody degradation. Explain the functions and biological properties of a particular class of antibodies. Explain the mechanism of cell uterine antibody-dependent cytotoxicity. Describe natural-killing (NK) activity, receptors on the surface of NK cells, and lymphokine-activated killer activity (LAC). Describe the classical, lectin, and alternative complement activation pathway. Describe the biological role of complement.

Learning material:

Chapter 12: Cell Activation and Antibody Production, pages 239-263. Chapter 13: Effector Mechanisms of Humoral Immunity, pages 265-288. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 8: Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues

After the course, students should be able to:

To describe the structure of the immune system at the epithelial barriers. To describe the immunity of the digestive system and other mucous membranes. To describe the function of M cells. To explain the induction of the mucosal TH2 immune response. To explain the induction of the mucosal inflammatory TH1 immune response. To explain the structure, function, and secretion of IgA antibodies. To explain the function of γδ-T lymphocytes. To explain the function of immunoregulatory cytokines (TGF-beta, IL-10) and regulatory T lymphocytes in mucosal immunity. To describe the immunity of the skin and immune-privileged tissues.

Learning material:

Chapter 14: Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues, p. 289-313. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 9: Hypersensitivity Disorders

After the course, students should be able to:

To define the term immunologic hypersensitivity, to name the classification of immunologic hypersensitivity, and to describe their main characteristics. To explain the immune diseases caused by antibodies. To explain hypersensitivities caused by immunocomplexes. To explain diseases caused by T lymphocytes. To explain cell-dependent hypersensitivity features, tuberculin response, and contact hypersensitivity. To describe the pathogenesis and treatment strategies of selected immune diseases (SLE, RA, multiple sclerosis, type 1 diabetes, inflammatory bowel diseases).

Learning material:

Chapter 19: Hypersensitivity Disorders, pages 399-416. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 10: Immunologic Tolerance and Autoimmunity

Learning outcomes - After the course, students should be able to :

Explain the term immunologic tolerance, the mechanisms for establishing tolerance at birth, and in adulthood. Describe the factors that affect tolerance (maturity of the immune system, antigen features, antigen dose, and antigen intake pathway). Explain the mechanisms of central (perinatal) and peripheral immunologic tolerance (disappearance of clones, clonal anergy, immune neglect, immune-privileged sites, redirection of the immune response, facilitative antibodies, and blocking factors), and mechanisms of immunologic tolerance termination. Describe the active suppressive mechanism at the periphery, the suppressive cells, and the activity of suppressive cytokines. Describe the immunologic relationship between a mother and a child and the mechanisms that prevent fetal rejection. Explain the term autoimmunity, mechanisms for autoimmunity occurrence (the role of autoantigen, the role of external antigen as an immunogenic carrier, to describe the cross-reaction). To describe the features of autoreactive T and B lymphocyte occurrence at the periphery. Explain the pathogenic mechanisms of autoimmunity and the mechanisms of tissue and organ damage by antibodies, antigen-antibody complexes, and T lymphocytes. Describe autoimmune diseases and their classification, genetic factors of autoimmunity, the influence of gender, age, infections, and immunologic disorders on the occurrence of autoimmunity. Name the principles of treating autoimmune diseases.

Learning material:

Chapter 15: Immunologic Tolerance and Autoimmunity, pages 315-337. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 11: Allergy

After the course, students should be able to:

Define the term allergy. Describe the formation of IgE-class antibodies. Explain the role of TH2 cells, mast cells, basophils, and eosinophils in allergic reactions. Explain anaphylactic hypersensitivity and its forms. Describe IgE-class antibodies and receptors for the Fc fragment of IgE, to describe target cell degranulation, as well as secretion and function of mediator substances (primary and secondary mediators). Describe allergic diseases in humans and the principles of their treatment.

Learning material:

Chapter 20: Allergy, pages 417-435. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 12: Immunity to Tumors

After the course, students should be able to:

Describe tumor antigens, their subtypes, properties, and methods for demonstrating tumor antigens and human tumor antigens. Describe the immune response to the tumor, and subtypes of immune resistance to a tumor (cellular and humoral immunity). Understand the theory of immune surveillance over tumor cells, and tumor suppression mechanisms to immune defense. Describe the tumor immunotherapy and its subtypes. Describe the role of innate and adaptive immunity in promoting tumor growth.

Learning material:

Chapter 18: Immunity to Tumors, pages 383-397. FromAbbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Lecture 13: Congenital and Acquired Immunodeficiencies

After the course, students should be able to:

Define immunodeficiency and its classification. Explain primary immunodeficiencies and disorders of their immune effectors (deficiency of B lymphocytes, T lymphocytes, phagocytes, complement system, and associated T and B lymphocyte deficiencies). Explain secondary immunodeficiencies and the reasons for their occurrence. Describe the structure and biological behavior of HIV, the way of transmission, the mechanism by which it causes AIDS, AIDS (incubation, seroconversion, symptoms, and the course of the disease).

Learning material:

Chapter 21: Congenital and Acquired Immunodeficiencies, pages 437-463. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

[Seminari] list (with titles and explanation):

Seminar 1: Properties and Overview of Immune Responses, Cells and Tissues of the Immune System, Leukocyte Circulation and Migration into Tissues, Innate Immunity

Discussion: Content of Lecture 1 and Big seminar 1

Learning material:

Chapter 1: Properties and Overview of Immune Responses, pages 1-12. Chapter 2: Cells and Tissues of the Immune System, pages 13-33. Chapter 3: Leukocyte Circulation and Migration into Tissues, pages 35-50. Chapter 4: Innate Immunity, pages 51-86. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Big seminar 1: Innate Immunity

After the course, students should be able to:

Describe the development and the mechanisms for innate immunity (anatomical, physiological, cellular, inflammatory obstacles). Name the cellular receptors for molecular pattern recognition and their function in innate immunity. To describe the mechanism of chemotaxis, endocytosis, and phagocytosis, and decomposition of phagocytic particles. Describe classical, lectin, and alternative complement activation pathways. Describe the biological role of the complement. Describe the regulation of complement activation. Define inflammation and to describe the mechanism of inflammatory response. Describe the mechanism of innate antiviral response.

Learning material:

Chapter 4: Innate Immunity, pages 51-86. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Big seminar 2: Immunity to Microbes

After the course, students should be able to:

Explain the terms parasitism, pathogenicity, virulence, and infection. Describe the features of the immune response (non-specific and specific immunity) to pathogenic microbes. Explain the features of specific immunity in infections, specific active immunity acquired naturally, and artificially triggered specific active immunity, the concept, and principle of vaccination and forms of specific passive immunity (acquired naturally and artificially triggered specific passive immunity). Describe the basic features of viruses, bacteria, single-cell and multiple-cell parasites, and

infections caused by these parasites. Explain the features of innate and adaptive immunity to extracellular and intracellular bacteria, fungi, viruses, and single-cell and multiple-cell parasites.

Learning material:

Chapter 16: Immunity to Microbes, pages 339-354. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Big seminar 3: Transplantation Immunology

After the course, students should be able to:

Define levels of immunogenic compatibility. Explain the principles of transplant immunology. Explain the mechanisms of transplant response, to name the evidence that transplant response is an immune response. Name and describe the forms of transplant response depending on the rate and the rejection mechanism, and to describe the reaction of mixed lymphocytes. Explain the features of non-lymphatic tissue and organ transplantation and xenogeneic organ transplantation. Explain the features of lymphatic tissue transplantation (bone marrow), the reaction of the graft against the receiver, and the transplant disease.

Learning material:

Chapter 17: Transplantation Immunology, pages 359-371 and 376-381. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Priručnik za vježbe iz fiziologije, neurofiziologije i imunologije [Handbook for Practicals in Physiology, Neurophysiology, and Immunology], Rijeka, 2001, practical no. 20.

Seminar 2: Differentiation and Functions of CD4+ and CD8+ Effector T Cells

Discussion: Content of Lecture 2, 4, and 5

Learning material:

Chapter 10: Differentiation and Functions of CD4+ Effector T Cells, pages 213-230. Chapter 11: Differentiation and Functions of D8+ Effector T Cells, pages 231-238. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Seminar 3: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues

Discussion: Content of the Lecture 7 and 8, and Big seminar 2 The training section includes presentations of cases of Chron's disease/ulcerative colitis and sepsis.

Learning material:

Chapter 13: Effector Mechanisms of Humoral Immunity, pages 265-288. Chapter 14: Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues, pages 289-313. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Big seminar 4: Immunosuppression; Vaccination

After the course, students should be able to:

Describe the possibilities for action on the intensity of the immune response (immunosuppression, immunostimulation). Explain immunosuppression, mechanisms for inducing specific (suppression of immune response by antigens, antibodies, antilymphocyte serum, monoclonal antibodies) and non-specific (corticosteroids, cytostatics) immunosuppression. Explain immunostimulation procedures by vaccination for protection against infection. Name the properties of vaccines and their types. Explain vaccination by weakened pathogens. Explain vaccination by conjugated vaccines. Explain vaccination against bacterial toxins. Explain vaccination by recombinant, alive viral, and DNA vaccines. Describe the methods of genetic engineering in methods of preparing antitumor vaccines and enhancement of antitumor immune response. Name the types of adjuvants and to explain the principles of their action.

Learning material:

Chapter 17: Transplant immunology (Prevention and treatment of graft rejection), pages 371-376. Chapter 16: Immunity to microorganisms (Vaccine Development Strategies), pages 354-357. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Seminar 4: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity

Discussion: Lectures 9, and 10 The training section includes a video of anaphylactic shock in a guinea pig and a display of cases of allergy and autoimmune disease (rheumatoid arthritis).

Learning material:

Chapter 15: Immunotolerance and Autoimmunity, pages 315-337. Chapter 19: Hypersensitivity disorders, pages 399-416. Chapter 20: Allergy, pages 417-435. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Seminar 5: Innate and acquired immunodeficiencies. Immunity to tumors.

Repetition: Lectures 12, and 13

Learning material:

Chapter 18: Immunity to Tumors, page 383-397. Chapter 21: Innate and Acquired Immunodeficiencies, pages 437-463. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

[Vježbe] list (with titles and explanation):

Practical 1: Antibodies and Antigens

Discussion: Content of Lecture 3 The training section includes PhysioEx 9.1 Exercise 12: Serological Testing; Activity 1: Use of direct immunofluorescence technique in pathogen detection; Activity 3: ELISA.

Learning material:

Chapter 5: Antibodies and Antigens, pages 87-105. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Practical 2: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues

Discussion: Content of the Lecture 7 and 8, and Big seminar 2

The training section includes presentations of cases of Chron's disease/ulcerative colitis and sepsis.

Learning material:

Chapter 13: Effector Mechanisms of Humoral Immunity, pages 265-288. Chapter 14: Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues, pages 289-313. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Practical 3: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity

Discussion: Lectures 9, and 10

The training section includes a video of anaphylactic shock in a guinea pig and a display of cases of allergy and autoimmune disease (rheumatoid arthritis).

Learning material:

Chapter 15: Immunotolerance and Autoimmunity, pages 315-337. Chapter 19: Hypersensitivity disorders, pages 399-416. Chapter 20: Allergy, pages 417-435. Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Practical 4: Innate and acquired immunodeficiencies. Immunity to tumors.

Repetition: Lectures 12, and 13

Learning material:

Chapter 18: Immunity to Tumors, page 383-397. Chapter 21: Innate and Acquired Immunodeficiencies, pages 437-463. From Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Tenth edition. Elsevier, 2021.

Student obligations:

Attendance. Attendance at lectures, seminars and practical courses is compulsory. The student can miss a maximum of 30% of the lectures and 30% of the seminars/practicals, whereby the absence must be justified. Any absence from the seminar/practical must be examined orally and confirmed by a seminar/practical instructor (colloquium) in order to be admitted to the final examination.

Exam (exam taking, description of the written/oral/practical part of the exam, point distribution, grading criteria):

ECTS grading system

Students are graded in accordance with the current study regulations of the University of Rijeka and the Regulation on the Grading of Students at the Faculty of Medicine in Rijeka.

Students' work and performance are assessed and graded during the course, which is the basis for the final grade. Students' work and competencies are assessed during the course with a maximum of 70 points and up to 30 points in the final exam, which gives a total of 100 points. Students are graded according to the ECTS (A-E) and the numerical system (1-5). Grading according to the ECTS system is based on absolute redistribution as well as the graduate grading criteria.

I The following components are evaluated during the course (maximum of 70-grade points):

Attendance. Attendance at lectures, seminars and practical courses is compulsory. The student can miss a maximum of 30% of the lectures and 30% of the seminars/practicals, whereby the absence must be justified. Any absence from the seminar/practical must be examined orally and confirmed by a seminar/practical instructor (colloquium) in order to be admitted to the final examination.

Adopted knowledge (up to 70 points)

During the course, the acquired knowledge is assessed by two mid-term exams (MTE) with 70 multiple-choice questions test, which take place in April (first mid-term exam) and June (second mid-term exam). A student can receive up to 35 grade points for each exam:

Correct answers	Grade points		Correct answers	Grade points
68-70	35		49	25
65-67	34		48	24
62-64	33		47	23
60-61	32		45-46	22
58-59	31		43-44	21
56-57	30		41-42	20
54-55	29		39-40	19
52-53	28		37-38	18
51	27		35-36	17,5
50	26			

Examination conditions. The mid-term examination takes the form of an online multiple-choice test with 70 questions, which can be completed in 75 minutes. It is recommended to provide a stable internet connection and a computer that fully supports online operation in Merlin and MS Teams. If a student is unable to provide a stable connection and/or computer, the exam can be organized in the faculty computer classroom. The exam will be conducted via the Safe Exam Browser (SEB), which must be installed on the computer and tried out before the exam. Students will be asked to enter the virtual exam room, which will be launched on the Microsoft Teams (MS Teams) platform. During the exam, students must be connected to MS Teams. The SEB should be run after starting and entering the MS Teams virtual exam room. If the internet connection is interrupted during the exam, students can log back in and resume the exam, with all attempts and interruptions automatically recorded in the Merlin program. Any interruption may result in solution attempts being saved without an answer being recorded, which may ultimately result in an incorrect and unrecognized answer. It is therefore the responsibility of each

student to ensure a good internet connection.

Students who do not achieve the minimum score on one or both MTEs may retake one or both MTEs, which will take place in June between the first and second term of final exams. For repeated MTEs, a student may earn grade points according to the table above and correct/improve the final grade.

Improvement of the overall performance during the course. Students who have achieved sufficient points in a regular MTEs can improve their final grade in the repeated MTEs/MTEs.

Additional acquisition of minimum requirements for the final examination. Students who have not achieved the minimum score in one of the MTEs can make up the minimum requirements for the final exam. This will be organized at the beginning of September. The minimum grade is acquired by writing one or both tests covering the material of the first and/or second MTE. Students cannot earn additional grade points on the minimum requirement tests. With a positive test result (more than 50%), a student can obtain the pass mark (20.0 + 20.0).

II Final examination (up to 30 grade points)

Students who have achieved 45-70 grade points in class are obliged to take the final examination, in which they can receive additional grade points. The final exam consists of a test with multiple-choice questions and an oral part.

Students who have achieved less than 35 points in class or have been absent for more than 30% of the lessons are not allowed to take the final exam (insufficient F).

Students can achieve 10-30 grade points in the final examination. The final examination consists of an oral and a written part in which students must demonstrate at least 50% of the knowledge, skills and competencies. A student who demonstrates at least 50% of the knowledge, skills and competences in the written and oral parts of the examination will be credited with points according to the result achieved, which will be added to the grade points achieved in class.

For the written part of the final examination, a student can receive 14-25 points according to the table:

Correct answers	Grade points		Correct answers	Grade points
96-100%	25		72-75,9%	19
92-95,9%	24		68-71,9%	18
88-91,9%	23		64-67,9%	17
84-87,9%	22		60-63,9%	16
80-83,9%	21		56-59,9%	15
76-79,9%	20		50-55,9%	14

At the oral part of the final exam, a student can obtain 1-5 grade points that are divided into 5 categories (1, 2, 3, 4, 5). Minimum required in 1 point.

Points earned in the written and oral parts are added together. The final exam is considered passed if the student has achieved a minimum of 14 points in the written and a minimum of 1 point in the oral part of the exam.

The final exam is an integral unit, and if the student does not achieve a positive grade in the oral part of the exam, the results of the written part of the final exam are not valid in the next exam periods.

III. The final grade (maximum of 100 grade points)

The final grade represents the sum of all grade points obtained during classes and at the final exam. It is based on the absolute redistribution according to the following scale:

90-100 grade points	A	excellent (5)

75-89,99 grade points	B	very good (4)
60-74,99 grade points	C	good (3)
50-59,99 grade points	D	sufficient (2)
less than 50-grade points	E	insufficient (1)

Other notes (related to the course) important for students:

Other important information regarding the course:

Course content and all information regarding the course, including exam information, can be found at Merlin.

COURSE HOURS 2023/2024

Immunology

[Predavanja] (Place and time or group)	**[Vježbe]** (Place and time or group)	**[Seminari]** (Place and time or group)
04.03.2024		
Lecture 1: Properties and Overview of Immune Responses. Cells and Tissues of the Immune System. Leukocyte Circulation and Migration into Tissues.: • [P15 - VIJEĆNICA] (08:15 - 10:00) [143] ◦ I_334		
prof. dr. sc. Lučin Pero, dr. med. [143]		
11.03.2024		
		Big seminar 1: Innate Immunity: • [P15 - VIJEĆNICA] (09:15 - 11:00) [210] ◦ I_334
prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
13.03.2024		
		Seminar 1: Properties and Overview of Immune Responses, Cells and Tissues of the Immune System, Leukocyte Circulation and Migration into Tissues, Innate Immunity: • [P04] (13:15 - 15:30) [209] ◦ Group I - B
prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		
14.03.2024		
		Seminar 1: Properties and Overview of Immune Responses, Cells and Tissues of the Immune System, Leukocyte Circulation and Migration into Tissues, Innate Immunity: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [211] ◦ Group I - A
doc. dr. sc. Gulić Tamara, mag. biol. [211]		
18.03.2024		
Lecture 2: Antibodies and Antigens: • [P15 - VIJEĆNICA] (09:15 - 11:00) [210] ◦ I_334		
prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
19.03.2024		
Lecture 3: Major Histocompatibility Complex Molecules and Antigen Presentation to T Lymphocytes: • [P01] (09:15 - 11:00) [143] ◦ I_334		
prof. dr. sc. Lučin Pero, dr. med. [143]		

25.03.2024		
Lecture 4: Immune Receptors and Signal Transduction. Activation of T Lymphocytes.: • [P15 - VIJEĆNICA] (09:15 - 11:00) [209] ◦ I_334		
prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		
27.03.2024		
	Practical 1: Antibodies and Antigens: • [P08] (13:15 - 15:30) [1261] ◦ Group I - B	
Radić Barbara [1261]		
28.03.2024		
	Practical 1: Antibodies and Antigens: • [P04] (13:15 - 16:00) [211] ◦ Group I - A	
doc. dr. sc. Gulić Tamara, mag. biol. [211]		
02.04.2024		
Lecture 6: Differentiation and Functions of CD4+ and CD8+ Effector T Cells: • [P08] (09:15 - 11:00) [143] ◦ I_334		
prof. dr. sc. Lučin Pero, dr. med. [143]		
03.04.2024		
Lecture 5: Lymphocyte Development and Antigen Receptor Gene Rearrangement: • [P08] (09:15 - 11:00) [211] ◦ I_334		
doc. dr. sc. Gulić Tamara, mag. biol. [211]		
08.04.2024		
Lecture 7: B Cell Activation and Antibody Production. Effector Mechanisms of Humoral Immunity: • [P08] (08:15 - 00:00) [143] ◦ I_334		
prof. dr. sc. Lučin Pero, dr. med. [143]		
10.04.2024		
		Seminar 2: Differentiation and Functions of CD4+ and CD8+ Effector T Cells: • [Zavod za fiziologiju - Seminarska] (13:15 - 15:30) [143] ◦ Group I - A
prof. dr. sc. Lučin Pero, dr. med. [143]		

11.04.2024		
		Seminar 2: Differentiation and Functions of CD4+ and CD8+ Effector T Cells: • [P05] (13:15 - 15:30) [210] ○ Group I - B
prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
24.04.2024		
Lecture 8: Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues: • [P15 - VIJEĆNICA] (13:15 - 15:00) [143] ○ I_334		
prof. dr. sc. Lučin Pero, dr. med. [143]		
25.04.2024		
		Big seminar 2: Immunity to Microbes: • [P09 - NASTAVA NA ENGLESKOM JEZIKU] (13:15 - 15:00) [210] ○ I_334
prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
29.04.2024		
Lecture 9: Hypersensitivity Disorders: • [P08] (09:15 - 11:00) [143] ○ I_334		
prof. dr. sc. Lučin Pero, dr. med. [143]		
08.05.2024		

	Practical 2: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues:
	• [P08] (14:00 - 15:30) [1397]
	  ○ Group I - A
		Seminar 3: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues:
		• [P08] (13:15 - 14:00) [1397]
		  ○ Group I - A

Viduka Ivona [1397]		
09.05.2024		

	Practical 2: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues:
	• [P09 - NASTAVA NA ENGLESKOM JEZIKU] (14:00 - 15:30) [210]
	  ○ Group I - B
		Seminar 3: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues:
		• [P09 - NASTAVA NA ENGLESKOM JEZIKU] (13:15 - 14:00) [210]
		  ○ Group I - B

prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
13.05.2024		

Lecture 10: Immunologic Tolerance and Autoimmunity: • [P08] (09:15 - 11:00) [214] ◦ I_334		
prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
15.05.2024		

Lecture 11: Allergy:
• [P08] (09:15 - 10:00) [209]
  ◦ I_334
 	
Lecture 12: Immunity to Tumors:
• [P08] (10:15 - 11:00) [209]
  ◦ I_334		

prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		
20.05.2024		
		Big seminar 3: Transplantation Immunology: • [P08] (09:15 - 11:00) [209] ◦ I_334
prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		
22.05.2024		

	Practical 3: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity:
	• [P08] (14:00 - 15:30) [214]
	  ◦ Group I - A
		Seminar 4: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity:
		• [P08] (13:15 - 14:00) [214]
		  ◦ I_334
		  ◦ Group I - A

prof. dr. sc. Mrakovčić-Šutić Ines, dr. med. [214]		
23.05.2024		

	Practical 3: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity:
	• [P09 - NASTAVA NA ENGLESKOM JEZIKU] (14:00 - 15:30) [210]
	  ◦ Group I - B
		Seminar 4: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity:
		• [P09 - NASTAVA NA ENGLESKOM JEZIKU] (13:15 - 14:00) [210]
		  ◦ Group I - B

prof. dr. sc. Mahmutefendić Lučin Hana, dipl. ing. biol. [210]		
27.05.2024		
Lecture 13: Congenital and Acquired Immunodeficiencies: • [P08] (09:15 - 11:00) [209] ◦ I_334		
prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		
29.05.2024		

	Practical 4: Innate and acquired immunodeficiencies. Immunity to tumors.: • [Zavod za fiziologiju - Seminarska] (14:45 - 15:30) [143] ◦ Group I - B • [P08] (14:45 - 15:30) [209] ◦ Group I - A	Seminar 5: Innate and acquired immunodeficiencies. Immunity to tumors.: • [Zavod za fiziologiju - Seminarska] (13:15 - 14:45) [143] ◦ Group I - B • [P08] (13:15 - 14:45) [209] ◦ Group I - A
prof. dr. sc. Lučin Pero, dr. med. [143] · prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		
10.06.2024		
		Big seminar 4: Immunosuppression; Vaccination: • [P15 - VIJEĆNICA] (09:15 - 11:00) [209] ◦ I_334
prof. dr. sc. Trobonjača Zlatko, dr. med. [209]		

List of lectures, seminars and practicals:

[PREDAVANJA] (TOPIC)	Number of hours	Location
Lecture 1: Properties and Overview of Immune Responses. Cells and Tissues of the Immune System. Leukocyte Circulation and Migration into Tissues.	2	[P15 - VIJEĆNICA]
Lecture 2: Antibodies and Antigens	2	[P15 - VIJEĆNICA]
Lecture 3: Major Histocompatibility Complex Molecules and Antigen Presentation to T Lymphocytes	2	[P01]
Lecture 4: Immune Receptors and Signal Transduction. Activation of T Lymphocytes.	2	[P15 - VIJEĆNICA]
Lecture 5: Lymphocyte Development and Antigen Receptor Gene Rearrangement	2	[P08]
Lecture 6: Differentiation and Functions of CD4+ and CD8+ Effector T Cells	2	[P08]
Lecture 7: B Cell Activation and Antibody Production. Effector Mechanisms of Humoral Immunity	2	[P08]
Lecture 8: Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues	2	[P15 - VIJEĆNICA]
Lecture 9: Hypersensitivity Disorders	2	[P08]
Lecture 10: Immunologic Tolerance and Autoimmunity	2	[P08]
Lecture 11: Allergy	2	[P08]
Lecture 12: Immunity to Tumors	2	[P08]
Lecture 13: Congenital and Acquired Immunodeficiencies	2	[P08]

[VJEŽBE] (TOPIC)	Number of hours	Location
Practical 1: Antibodies and Antigens	3	[P04] [P08]
Practical 2: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues	2	[P08] [P09 - NASTAVA NA ENGLESKOM JEZIKU]

Practical 3: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity	2	[P08] [P09 - NASTAVA NA ENGLESKOM JEZIKU]
Practical 4: Innate and acquired immunodeficiencies. Immunity to tumors.	1	[P08] [Zavod za fiziologiju - Seminarska]

[SEMINARI] (TOPIC)	Number of hours	Location
Seminar 1: Properties and Overview of Immune Responses, Cells and Tissues of the Immune System, Leukocyte Circulation and Migration into Tissues, Innate Immunity	3	[P04] [Zavod za fiziologiju - Seminarska]
Big seminar 1: Innate Immunity	3	[P15 - VIJEĆNICA]
Big seminar 2: Immunity to Microbes	3	[P09 - NASTAVA NA ENGLESKOM JEZIKU]
Big seminar 3: Transplantation Immunology	3	[P08]
Seminar 2: Differentiation and Functions of CD4+ and CD8+ Effector T Cells	3	[P05] [Zavod za fiziologiju - Seminarska]
Seminar 3: Infection immunity. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues	1	[P08] [P09 - NASTAVA NA ENGLESKOM JEZIKU]
Big seminar 4: Immunosuppression; Vaccination	3	[P15 - VIJEĆNICA]
Seminar 4: Hypersensitivity Disorders; Allergy; Immunologic Tolerance and Autoimmunity	1	[P08] [P09 - NASTAVA NA ENGLESKOM JEZIKU]
Seminar 5: Innate and acquired immunodeficiencies. Immunity to tumors.	2	[P08] [Zavod za fiziologiju - Seminarska]

EXAM DATES (final exam):

1.	17.06.2024.
2.	01.07.2024.
3.	15.07.2024.
4.	09.09.2024.
5.	23.09.2024.