Sveučilište u Rijeci • Fakultet dentalne medicine
University of Rijeka • Faculty of Dental Medicine

Course: Immunology
Course Coordinator: Tamara Gulic, PhD, Assistant Professor
Department: Department of Physiology, Immunology, and Pathophysiology
Study: Integrated Undergraduate and Graduate University Study of Dental Medicine
Year of the study: Second
Academic year: 2022/2023

COURSE SYLLABUS

Course information (basic description, general information, teaching overview, required equipment, and preparation, etc.
Immunology is a mandatory course in the study of Dental Medicine, it is listened to during the 2nd year of study. The coures is carried out in a continuous during the two weeks. The course consists of 20 hours of lectures and 10 hours of seminars, which totals 30 class hours.
The main aim of this course is to introduce students to the normal and pathological function of the immune system. The student will acquire the basic knowledge in: 1) the role of the immune system: a) maintenance of homeostasis in the whole organism and oral cavity, and b) ethiopathogenesis of local and systemic disorders and disorders in the organism, with the focus at the oral cavity. 2) possibilities of using immunological methodology in modern diagnostics. 3) possibilities of using modern biotechnological methods in immunotherapy. The planned outcome of the course is to acquire the knowledge in the field of basic immunology and immunopathophysiology, and to acquire the ability to vertically upgrade the knowledge in clinical subjects that follow.
Course content:
Overview of Immunity. Tissue Cells and Organs of the Immune System. Major Histocompatibility Complex Molecules. Immune Recognition. Innate Immunity. NK cells. Cellular Immunity, Lymphocyte B and T, Activation and collaboration of immune cells, Antigens and antibodies, Structure, and function of immunoglobulins. Complement. Immunotolerance. Immune Response Regulation. Major Histocompatibility genes and antigens. Autoimmune disease. Immunological Hypersensitivity. Immunodeficiency. Mucosal Immunity (especially of the oral cavity and teeth (caries, gingivitis, periodontitis, ulcerations, candidiasis, AIDS)). Vaccination.
Class organization:
The course consist of lectures and seminars. The seminars continue thematically on the material covered in the lecture. Throughout lectures and seminars, the student actively discusses immune mechanisms with the lecturer. Students are obligated to regularly attend and actively participate in all forms of classes. The teacher/course coordinator continuously evaluates student participation throughout seminars (demonstrated knowledge, understanding, the ability to set up a problem, concluding, etc.). Consultations are held in agreement with students during and after the immunology classes.

Required textbooks:

Abbas A.K, Lichtman A.H., Pillai S. Basic Immunology. Functions and Disorders of the Immune System. Fifth edition. Elsevier, 2016.
Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology. International Edition. Eighth edition. Elsevier, 2015.

Recommended for additional reading:

Course teaching plan

List of lectures (with titles and learning outcomes)

Lecture 1: Organization of Immune system. Immune cells and immune tissue

Learning outcomes:

To describe the role of immune reaction. To understand the features of immune reactions.
To name and explain the classification of adaptive immunity according to the mode of acquisition and executive mechanisms (humoral and cellular immunity).
To describe the anatomy and function of lymphatic tissues (bone marrow, thymus, lymphatic system, lymph nodes, spleen, and regional lymphatic systems).
To describe the morphological, physical, and biological properties of cells of the immune system. To name the subtypes of T and B lymphocytes and to describe their function.
To describe the basic features and function of NK cells.
To explain the importance of non-specific immunity in initiating an immune response. To explain the importance of antigen presenting cells.
To describe and explain the phases of the immune response. To describe the term lymphocyte clone.

Lecture 2: Innate immunity

Learning outcomes:

To describe the development and the mechanisms for non-specific immunity (anatomical, physiological, cellular, inflammatory obstacles).
To name the cellular receptors for molecular pattern recognition and their function in non-specific immunity.
To explain the process of phagocytosis, name the subtypes of phagocytic cells and explain the biological properties and function of phagocytic cells.
To understand the role of NK cells.
To understand the importance of innate immunity in initiating an immune response. To explain the function of antigen presentig cells.
To describe classical, lectin, and alternative complement activation pathways. To describe the biological role of the complement.

Lecture 3: Antigen presentation. Major histocompability molecules.

Learning outcomes:

To describe the system of tissue antigens, their classification, structure, and function of MHC group I and II antigens, and distribution in the organism.
To understand the term of processing and displaing antigrns by MHC molecules. To describe the structure of the receptor for the T lymphocyte antigen.
To understand the MHC gene structure (polygeny and polymorphism).
To describe the role of the MHC gene in determining immunoreactivity characteristics (in controlling the response to individual antigens, in the appearance of autoimmune diseases, in the appearance of high alloreactivity).
To explain the processing of another's antigen and the mechanism of its binding to MHC class I and II molecules To explain the basic principles of immune recognition. To explain the significance of the first and second signals during the activation of naive T lymphocytes.
To explain the principle of clonal selection in the thymus.

Lecture 4: Lymphocytes receptors. Antigens and antibodies.

Learning outcomes:

To describe the term antigen, classification of antigens, antigen determinant (epitope), and its forms. To define the term immunogenicity, the factors that affect the antigen

immunogenicity.
To describe the structure of antibodies, their heterogeneity and antigenic determinants, the primary structure of paratopes.
To describe the course of clone specialization of B lymphocytes for a particular bone marrow specificity. To describe the structure of the receptor for the B lymphocyte antigen.
To understand the concept of antigen recognition by MHC molecules.
To describe the processes of T lymphocyte development and the role of the thymus in them. To describe the processes of B lymphocyte development and selection in the bone marrow.

Lecture 5: T Cell-Mediated Immunity

Learning outcomes:

To explain the mechanisms and main features of T Cell-Mediated Immunity.
To understand the role of adhesion and costimulation molecules in the activation of T lymphocytes. To understand and explain the process of naive T lymphocytes differentiation into effector cells.
To describe cytokine secretion as a mechanism to enhance T lymphocyte-mediated immunity.
To explain the kinetics of the immune response mediated by T lymphocytes.
To describe the characteristics and to explain the executive roles of cytotoxic T lymphocytes and the mechanism of target-cell killing.
To explain macrophage activation by sensitized T lymphocytes of TH1 subtype. To explain the activation and function of T lymphocytes of the TH17 subtype.

Lecture 6: Humoral Immunity

Learning outcomes:

To describe the structure and the function of the B lymphocyte receptor.
To describe the morphology of B lymphocyte differentiation, plasma cell, and memory cell formation.
To explain the antibody production kinetics in the primary and secondary immunoreaction, distribution throughout the body, and the dynamics of antibody degradation.
To explain and understand the process and significance of affinity maturation of B lymphocytes in secondary lymphatic organs.
To explain the functions and biological properties of different antibody classes.
To explain the effector mechanisms of humoral immunity: neutralization, opsonization, phagocytosis, ADCC reaction, complement activation.

Lecture 7: Immunity to infections

Learning outcomes:

To explain the concepts of parasitism, pathogenicity, virulence and infection.
To describe the peculiarities of immunoreaction (non-specific and specific immunity) to pathogenic microorganisms.
To explain the characteristics of specific immunity in infections, specific active immunity acquired naturally, and artificially induced, the concept and principles of vaccination and forms of specific passive immunity (naturally acquired and artificially induced).
To describe the basic characteristics of viruses, bacteria, unicellular and multicellular parasites, and the infections caused by these.
To explain the features of humoral and cellular immunity that occurs during viral and bacterial infections, and infections with unicellular and multicellular parasites.

Lecture 8: Mucosal Immunity

Learning outcomes:

To describe the immunity of the digestive system and other mucous membranes.
To explain the basic mechanisms by which the immune system provide immediate protect after pathogens invasion through mucosal tissue.
To describe the lymphocyte subtypes involved in mucosal immunity. To explain the role of IgA in mucosal immunity.
To understand the tolerance to microorganisms that are normally present in our body cavities and break of tolerance.

Lecture 9: Immunologic Tolerance and Autoimmunity. Hypersensitivity

Learning outcomes:

To explain the term autoimmunity and main mechanisms for autoimmunity occurrence.
To explain the pathogenic mechanisms of autoimmunity and the mechanisms of tissue and organ damage by antibodies, antigen-antibody complexes, and T lymphocytes.
To name the autoimmune diseases and their classification.
To define the term allergy, to name the classification of immunologic hypersensitivity, and to describe their main characteristics.
To 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).
To describe atopic reactions and principles of their treatment. To explain the immune diseases caused by antibodies.
To explain hypersensitivities caused by immunocomplexes and local (Arthus reaction) and generalized (serum sickness) form.
To explain cell-dependent hypersensitivity features, tuberculin response, and contact hypersensitivity.

Lecture 10: Immunodeficiencies and AIDS

Learning outcomes:

To define immunodeficiency and its classification.
To 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).
To explain secondary immunodeficiencies and the reasons for their occurrence.
To 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).
To describe the possible effects on the immunoreaction intensity (immunosuppression, immunostimulation). To explain immunosuppression, mechanisms of inducing specific (suppression of immunoreaction by antigen, antibodies, antilymphocyte serum, monoclonal antibodies) and non-specific (corticosteroids, cytostatics) immunosuppression.

Lecture 11: Vacctination

Learning outcomes:

To explain immunostimulation procedures by vaccination for protection against infection. To name the properties of vaccines and their types.
To explain vaccination by weakened pathogens. To explain vaccination by conjugated vaccines. To explain vaccination against bacterial toxins.
To explain vaccination by recombinant, alive viral, and DNA vaccines.
To describe the methods of genetic engineering in methods of preparing antitumor vaccines and enhancement of antitumor immune response.
To name the types of adjuvants and to explain the principles of their action.
To describe non-specific immunostimulation and immunomodulation procedures by combined immunosuppression and immunostimulatio.

List of seminars (with titles and learning outcomes)

Seminar 1: Organization of Immune system. Immune cells and immune tissue

Learning outcomes:

To name the main lymphatic organs and tissues, describe microscopic structure and histological changes in their structure after immunization.
To describe the concepts of lymphatic cells maturation and activation.
To name the lymphocytes subtypes, the main leukocyte differentiation markers on different immune cell subtypes and to describe their function.
To name the main T and B lymphocyte subtypes and to define their function. To define the basic characteristics and function of NK cells.
To explain the process of phagocytosis, list the subtypes of phagocytic cells, and define the biological

properties and function of phagocytic cells.
To name the antigen presenting cell subtypes, to explain the specific function of each subtype. To understand and describe the phases of the immune response.

Seminar 2: Antigen Presentation and Major Histocompatibility Complex Molecules

Learning outcomes:

To describe the system of tissue antigens, their classification, structure, and function of MHC group I and II antigens, and distribution in the organism.
To understand the term of processing and displaing antigrns by MHC molecules. To describe the structure of the receptor for the T lymphocyte antigen.
To understand the MHC gene structure (polygeny and polymorphism).
To describe the role of the MHC gene in determining immunoreactivity characteristics (in controlling the response to individual antigens, in the appearance of autoimmune diseases, in the appearance of high alloreactivity).
To explain the processing of another's antigen and the mechanism of its binding to MHC class I and II molecules To explain the basic principles of immune recognition. To explain the significance of the first and second signals during the activation of naive T lymphocytes.
To explain the principle of clonal selection in the thymus.

Seminar 3: T Cell-Mediated Immunity

Learning outcomes:

To explain the mechanisms and main features of T Cell-Mediated Immunity.
To understand the role of adhesion and costimulation molecules in the activation of T lymphocytes. To understand and explain the process of naive T lymphocytes differentiation into effector cells.
To describe cytokine secretion as a mechanism to enhance T lymphocyte-mediated immunity. To explain the kinetics of the immune response mediated by T lymphocytes.
To describe the characteristics and to explain the executive roles of cytotoxic T lymphocytes and the mechanism of target-cell killing.
To explain macrophage activation by sensitized T lymphocytes of TH1 subtype. To explain the activation and function of T lymphocytes of the TH17 subtype.

Seminar 4: Immunity to infections. Immunopathogenesis to HBV infection

Learning outcomes:

To define the principles of primary and secondary response to viral infection. Kinetics of IgM and IgG antibody responses.
To understand and explain the principles of the acute and chronic response to viral infection.
To name, understand and describe the immune mechanisms in the acute and chronic course of hepatitis B infection. To understand the principles of immune exhaustion and the disease shift to a chronic trend.

Seminar 5: Anaphylactic reaction

Learning outcomes:

To define the term anaphylactic hypersensitivity.
To define, name and describe the immune effector mechanisms involved in anaphylactic hypersensitivity (cells, primary and secondary mediators).
To define and explain systemic disorders that occur as a result of anaphylactic hypersensitivity. To explain the mechanisms of immune hypersensitivity to penicillin.

Student obligations:

Students are obligated to regularly attend and actively participate in all forms of classes. A student may be absent to 30% of all forms of classes only for justified reasons with the presentation of a credible certificate (medical certificate or similar).

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

ECTS grading system

Student grading is conducted according to the current Ordinance on Studies of the University of Rijeka.

Student work and achievement are assessed and graded during the course, which is the basis for the final grade. Student work and competencies are evaluated during classes with a maximum of 50% and up to 50% at the final exam. Students are graded according to the ECTS (A-E) and numerical system (1-5). Grading, according to the ECTS system, is conducted according to the absolute redistribution, as well as according to the graduate grading criteria.

I. Adopted knowledge during the course (up 50 points)

During classes, acquired knowledge will be evaluated by two midterm exams (MTE) comprising 50 questions, which will take place on February 4th, 2022 (First midterm exam), and on February 10st, 2022 (Second midterm exam). On tests for the acquisition of minimum conditions, students cannot earn additional grade points. With a positive test result (more than 50%), a student can earn the minimum number of grade points (12,5+12,5=25) and can access the Final exam. The first test (First midterm exam) includes the material of lectures P1-P5, and seminar S1-S2. The second test (Second midterm exam) includes the material of lectures P6-P11, and seminar S3-S5.

A student may obtain up to 25-grade points on each midterm exam:

Correct answers	Grade points		Correct answers	Grade points
48,49,50	25		31	17
45,46,47	24		30	16
42,43,44	23		29	15
39, 40,41	22		28	14
36,37,38	21		26,27	13
34,35	20		25	12,5
33	19			
32	18			

II. Final exam (up to 50-grade points)

Students who obtained 25-50 grade points during classes are obligated to access the final exam at which they may obtain additional grade points. The final exam consists of a multiple-choice questions test and an oral part.

- Students who obtained less than 25-grade points during classes or were absent for more than 30% of classes are not allowed to access the Final exam (insufficient F).

- Students can obtain 25-50 grade points at the final exam. The final exam consists of an oral and a written part, where students are expected to show at least 50% of knowledge, skills, and competencies. A student who demonstrates at least 50% of knowledge, skills, and competencies at the written and the oral part of the exam is credited with points according to the achieved result, which is added to the grade points obtained during classes.

At the written part of the final exam, a student can obtain 25-45 grade points according to the table:

Correct answers	Grade points		Correct answers	Grade points
49,50	45		35	33
47,48	44		34	32
46,45	43		33	31
44	42		32	30

43	41		31	29
42	40		30	28
41	39		29	27
40	38		28	26
39	37		27	25
38	36		25,26	24
37	35		0-24	0
36	34			

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).

The points obtain in the written and oral part are added up.

A STUDENT MUST SUCCESSFULLY PASS BOTH THE WRITTEN AND ORAL PART OF THE FINAL EXAM.

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	F	insufficient (1)

Other important information regarding the course:

Course content and all information regarding the course, including exam dates, can be found on the SharePoint platform of the Department of Physiology and Immunology on the following website: https://spp.uniri.hr/ss_medri/katedre/427 - can be accessed via an AAI address.

COURSE SCHEDULE for the academic year 2021/2022

Date	Course type		Time	Place	Lecturer
	Lecture	Seminar			
6.02.2023.	L1		8,15-10,00	*Seminar hall*	Doc. dr. sc. Tamara Gulić
6.02. 2023.	L2		10,30-12,15	*Seminar hall*	Prof. dr. sc. H. Mahmutefendić Lučin
07.02.2023.		S1	8,15-9,45	*Seminar hall*	Doc. dr. sc. Tamara Gulić
07.02.2023.	L3		10,30-12,15	*Seminar hall*	Prof. dr. sc. H. Mahmutefendić Lučin
08.02.2023.	L4		8,15-10,00	*Seminar hall*	Prof. dr. sc. Zlatko Trobonjača
8.02.2023.	L5		10,30-12,15	*Seminar hall*	Doc. dr. sc. Tamara Gulić
09.02.2023.		S2	8,15-9,45	*Seminar hall*	Dr. sc. Ljerka Karleuša
09.02.2023.	L6		10,30-12,15	*Seminar hall*	Prof. dr. sc. Pero Lučin
10.02.2023.		S3	8,15-9,45	*Seminar hall*	Dr. sc. Ljerka Karleuša
10.02.2023.	L7		8,15-10,00	*Seminar hall*	Prof. dr. sc. H. Mahmutefendić Lučin
10.02.2023.	L8		10,30-12,15	*Seminar hall*	Prof. dr. sc. Pero Lučin
13.02.2023.		S4	8,15-9,45	*Seminar hall*	Prof. dr. sc. Zlatko Trobonjača
13.02.2023.	L9		10,30-11,15	*Seminar hall*	Doc. dr. sc. Tamara Gulić
14.02.2023.	L10		11,30-12,15	*Seminar hall*	Doc. dr. sc. Tamara Gulić

14.02.2023.	L11		8,15-9,00	*Seminar hall*	Prof. dr. sc. Pero Lučin
14.02.2023.		S5	9,30-10,45	*Seminar hall/on line*	Dr. sc. Marina Marcelić
15.02.2023.		Final exam		*Seminar hall*	

FINAL EXAM DATES							
1.	15. 02. 2023.		3.	26. 06. 2023.		4.	12. 09. 2023.
2.	01.03. 2023.						

List of lectures, seminars, and practicals:

	LECTURES (topics)	Teaching hours	Place
L1	Organization of the immune systems. Immune cells and immune tissues.	2	*Seminar hall*
L2	Innate immunity.	2	*Seminar hall*
L3	Antigen presentation. Major histocompatibility molecules.	2	*Seminar hall*
L4	Lymphocyte receptors. Antigens and antibodies.	2	*Seminar hall*
L5	T-cell mediated immunity	2	*Seminar hall*
L6	Humoral immunity	2	*Seminar hall*
L7	Immunity to infections	2	*Seminar hall*
L8	Mucosal immunity	2	*Seminar hall*
L9	Immune tolerance and autoimmunity. Hypersensitivity.	2	*Seminar hall*
L10	Immunodeficiencies and AIDS.	1	*Seminar hall*
L11	Vaccination.	1	*Seminar hall*
	Total number of lecture hours	**20**	

	SEMINARS (topics)	Teaching hours	Place
S1	Organization of the immune systems. Immune cells and immune tissues.	2	*Seminar hall*
S2	Antigen presentation. Major histocompatibility molecules.	2	*Seminar hall*
S3	T-cell mediated immunity.	2	*Seminar hall*
S4	Immunity to infection. Immunopathogenesis of HBV infection.	2	*Seminar hall*
S5	Anaphylactic reaction.	2	*Seminar hall*
	Total number of seminar hours	**10**	

Course teaching plan by teaching units for the academic year
2022/2023

Schedule of lectures

MATERIAL
L1: Organization of the immune systems. Immune cells and immune tissues**.** Abbas et al: Basic Immunology 5th edition, Chapter (ch.) 1
L2: Innate immunity. Abbas et al: Basic Immunology 5th edition, Ch. 2
L3: Antigen presentation. Major histocompatibility molecules**.** Abbas et al: Basic Immunology 5th edition, Ch. 3
L4: Lymphocyte receptors. Antigens and antibodies**.** Abbas et al: Basic Immunology 5th edition, Ch. 4
L5: T-cell mediated immunity **T.** Abbas et al: Basic Immunology 5th edition, Ch. 5 and 6
L6: **Immunity to infections.** Abbas et al: Basic Immunology 5th edition, Ch. 7 and 8
L7: **Immunity to infections.** Abbas A.K, Lichtman A.H., Pillai S. Cellular and Molecular Immunology 8th edition, Ch. 16
L8: **Mucosal immunity.** Murphy K, Janeway's Immunobiology 8th edition, Ch. 12
L9: **Immune tolerance and autoimmunity. Hypersensitivity.** Abbas et al: I Basic Immunology 5th edition, Ch. 9 and 11.
P10: **Immunodeficiencies and AIDS.** **Abbas et al: Basic Immunology 5th edition, Ch. 12**
P11: Vaccination**.** Murphy K, Janeway's Immunobiology 8th edition, Ch. 16 (697-712)

Schedule of seminars

MATERIAL
S1: Organization of the immune systems. Immune cells and immune tissues**.** Abbas et al: Basic Immunology 5th edition, Ch. 1 and material discussed in the Lecture 1
S2: Antigen presentation. Major histocompatibility molecules**.** Abbas et al: Basic Immunology 5th edition, Ch. 3 and material discussed in the Lecture 3

S3: T-cell mediated immunity**.** Abbas et al: Basic Immunology 5th edition, Ch. 5 and 6 and material discussed in the Lecture 5
S4: Immunity to infection. Immunopathogenesis of HBV infection. Abbas et al: Cellular and Molecular Immunology 8th edition, Ch. 16 and material discussed in the Lecture 7
S5: Anaphylactic reaction**.** Abbas et al: Basic Immunology 5th edition, Ch. 9 and 11 and material discussed in the Lecture 9