UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Immunology and Pathology

**2627-3-E1301Q067**

## Aims

The course aims to provide the basic concepts on the organization and functioning of the immune system. Students attending the teaching of Immunology and Pathology are expected to achieve the following objectives:
Knowledge and understanding.
Know the bases of innate and adaptive immunity, the mechanisms underlying inflammation, generation of antigen-receptor receptor diversity, activation of T and B lymphocytes, structure and function of antibodies. Knowing basic concepts and principles concerning vaccination, knowing the basic concepts on diseases related to the malfunctioning of the immune system, such as autoimmune diseases and allergies.
Ability to apply knowledge and understanding.
Understanding the key role of the immune system in different pathologies and the importance of immunology, also through history.
Autonomy of judgment.
Being able to connect the different topics, to judge the resolved and unsolved aspects concerning the complexity of the immune system, and to highlight the shortcomings of current knowledge on the functioning of the immune system.
Critical thinking and judgment skills are developed during the lectures through guided discussions, case analyses, and problem-solving activities proposed by the instructor in class.
Communication skills.
Being able to effectively describe the contents of the course, both in written and oral form, using the most appropriate technical terms.
Learning ability.
Be able to consult scientific texts on the topics covered and integrate the knowledge acquired with the contents of other scientific disciplines of cellular, molecular and biochemical type.

## Contents

1) General features of the immune system

2) The antigen

3) The B cell antigen receptor (BCR)

4) The T cell antigen receptor (TCR)

5) The major hystocompatibility complex (MHC)

5) The process of antigen presentation

6) T and B lymphocyte activation

7) Cytokines and their receptors

8) Pattern Recognition Receptors

9) Cells of the innate immunity: myeloid cells and lymphoid cells

10) Complement

11) The inflammatory process

12) Effector mechanisms of humoral immunity

13) Effector mechanisms of cell-mediated immunity

14) Tolerance

15) Autoimmunty

16) Monoclonal antibodies

17) Hypersensibility, allergies

18) Transplants

19) Tumor immunology

20) Vaccines

## Detailed program

1: General characteristics of the immune system

Description : Innate and adaptive immunity; Organization of the immune system, general cahracteristics of organs, tissues and cells of the immune system. Primary and secondary lymphoid organs. Distribution and circulation of the cells of the immune system .

2: The antigen

Description: Concept of antigen, immunogen, antigenic detrminat or epitope, carrier, aptene.

3: The B cell antigen receptor (BCR)

Description: Immunoglobulins. structure nad function of antibodiese and of the BCR. The generation of repertoire diversity. Isotypes and idiotypes. Biological functions of immunoglobulins classes and subclasses. Cellular distribution of FC receptors . Cellular functions ediated by antibodies. monoclonal antibodies. Concept, methodology, applications.

4: The T cell receptor (TCR)

Description: organization, rearrangements and expression of TCR and coreceptors; biochemical structure of the TCR; generation of the repertoire diversity

5: The major histocompatibility complex (MHC)

Description: Genic organizationa and polymorphisms. Molecular structure and classification of MHC di class I and II molecules. The groove fro antigen binding. MHC di class I and II in antigen presentation. The ternary complex, MHC-peptide-TCR

6: Antigen presentation

Description: Antigen recognition by T and B cells. Extracellular and intracellular antigen processing.

7: Professional antigen presenting cells

Description: Dendritic cells

8: B and T cell activation.

Description: Signal transduction. Adhesion molecules and costimulatory molecules for T cell activation.

9: Cytokines and their receptors.

Description: Origine and molecular structure. Mechanism of action and target cells.Role of cytokine in leukocytes differentiation. Role of cytokines in Th1, Th2 and Th17 cell differentiation.

10: Interazioni microrganismi-ospite

Description: Pattern recognition receptor and Danger theory. PAMPs and DAMPs

11: The complement system

Description: Mecahnism of complement activation, functions of the complement

12: The inflammatory process

Description: Activation of inflammation, leukocyte recruitment, the role of inflammation in response to infection, from inflammation to the activation of adaptive immunity

13: Effector mechanisms of humoral immunity.

Description: T and B cell cooperation. Plasmacells. Isotype switch, hypermutation and affinity maturation. Kinetic of primary and secondary response

14: Effector mechanisms of cell-mediated immunity

Description: macrophage activation. Cytotoxic T lymphocytes and cell killing, effector mechanisms of t helper cells and NK cells

15: Immunological memory

Description: memory of T cells; memory of B cells

16: Immunological tolerance

Description: Central ena dperipheral tolerance, clonal deletion, extrinsic and intrinsic mechanisms of tolerance, regulatory T cells

17: Autoimmunity

Description:mechanisms of activation of autoimmune reactions , roles of innate and adaptinìve immunity in autoimmunity, systemic and organ-specific autoimmune diseases, risk factors

18: Hypersensibility allergies

Description: Type 1, 2, 3, 4 hypersensibility, mechanisms of activation od type 2 immunity, allergens, different forms of allergies, the role of IgEs, of mast cells and eosinophils

19: Transplantation

Description: syngeneic and allogeneic transplant, autotransplant, xenotrasplant, direct and indirect alloreactivity, hyperacute, acute and chronic rejection, strategies of imminesuppression

20: Tumor immunology

Description: tumor microenvironment, innate and adaptive immune responses against tumors, immunesuppression generated by tumors, tumor immunotherapies

21: Vaccines

Description: active and passive vaccination, prophylactic vaccines, therapeutic vaccines, adjuvants

## Prerequisites

Genetics and molecular biology

## Teaching form

All teaching activities are carried out in an expository (lecturing) mode.

The course includes 28 in-person frontal lectures, each lasting 2 hours, for a total of 56 hours.

The final two hours of the course are delivered in an interactive format. During these sessions, students engage in discussions, problem-solving activities, and group exercises.

The course is taught in Italian.

A 1-CFU module concerning the actin cytoskeleton of dendritic cells, its remodeling during maturation, and the processes of phagocytosis, pinocytosis and macropinocytosis in dendritic cells and macrophages, is co-taught with Dr. Metello Innocenti, expert in cell biology and cytoskeleton.

The lectures are recorded and made available to students through the e-learning platform to facilitate review and improve access to the course content.

## Textbook and teaching resource

The teaching material consists of lecture slides and recorded lessons available on the e-learning platform. Text books: Immunobiology, Janeway, Piccin-Nuova Libreria. Cellular and Molecular Immunology, Abbul Abbas and Andrew Lichtman

## Semester

First semester

## Assessment method

The final examination consists of an individual oral exam. No midterm tests are foreseen.

The exam includes two to five questions, depending on the student's level of preparation, covering all topics presented during the course.

The exam aims to assess:

- Knowledge and understanding of the mechanisms of innate and adaptive immunity;
- The ability to apply such knowledge to biological and pathological contexts;
- The ability to critically connect the various course topics;
- The use of appropriate scientific terminology and clarity in communication;
- Independent learning skills, including interdisciplinary integration.

Evaluation criteria include:

- Accuracy and completeness of answers;
- Logical connections between topics;
- Correct use of scientific language;
- Clarity and organization of discourse;
- Critical thinking and independent judgment.

The final grade, expressed in thirtieths, reflects the overall level of mastery demonstrated by the student with respect to the criteria above.

## Office hours

By appointment

## Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION