GENERAL IMMUNOLOGY (2015-16)

GENERAL INFORMATION

Code 26532

ECTS Credits 6

Departments and areas

Department	Area	Area	Report R.
BIOTECHNOLOGY	IMMUNOLOGY	YES	YES

Studies

DEGREE IN BIOLOGY

Context of subject

The word “immunology” comes from the latin "immunis" which means "no charge", understanding by charge a tax, law or disease. It is said that those individuals who do not succumb to the disease when infected are immune, and this state of resistance to a specific disease is called immunity. The first contributions of the Immunology to Biology and Medicine, departed from the idea that it was possible to induce immunity to pathogens preventing therefore the appearance of infectious diseases; hence, the rationale for vaccines represents the historical birth of immunology. Until the sixties of the last century, the greatest progress of Immunology occurred in the elucidation of the nature of the antibodies, complement and the antigen-antibody reaction. These advances have made possible development and improvement of serological diagnostic methods and their application to other fields, with the subsequent appearance of the radioimmunoassay and enzyme immunoassay. The last decades of the century witnessed the great boom of the studies concerning the critical role of cellular immunity in immune responses, which served to complete the knowledge of the acquired immunity mechanisms. More recently, innate immunity, their cells and molecules, have also occupied an important place in the study of the defense mechanisms.

Currently, Immunology is one of the greatest interest areas in the field of biology, especially in Health Sciences. The importance of this subject in the curriculum of the degree in biology is determined by several factors:

1) The immune response is a physiological process essential to understand the operational of organisms.

2) The immune response is a basic process in the context of infectious diseases and the immune system abnormalities constitute a group of very important pathologies.

3) Immune-based techniques currently used in laboratory are key to reach a proper diagnostic

In addition to the usual difficulties inherent in any discipline, we must be aware of the added challenges of immunology. Indeed, throughout this course students have to become familiar with new vocabulary (cytokine, Cluster of differentiation, Antigen and antibody, complement system, etc) that so far has been completely unknown to them. They should also learn to manage certain complex reagents and machines. So at the end of this program we only pursue the student to be able of knowing and understanding basic and fundamental aspects of Immunology, as well as to initiate themselves in the management of some of the main laboratory techniques used in such discipline.

OBJECTIVES

Subject objectives/competences (2015-16)

General:

- To provide students with the basic knowledge of the different elements of the immune system.
- To develop in students the ability to connect the acquired concepts, ie. to have an integrated Immunology vision, so that they can understand the multiple interactions happening between the different compartments of the immune system during a normal immune response.
- To highlight the experimental nature of Immunology and to promote acquisition of laboratory experimentation.
- To introduce students into the main pathologies derived from a quantitative, qualitative or functional impairment of the normal immune response.
- To familiarize students with the terminology and use of information sources (ICT) related with Immunology.

Cognitive:

- Understanding the cellular and molecular basis of innate and adaptive immune response.
- Understanding the mechanisms of antigen processing and presentation.
- To know how the selection of B and T lymphocytes repertoire is performed.
- To know kinetics and tissue localization of the immune response: uptake and antigen presentation, cell activation and apoptosis mechanisms, memory generation, recycling and nesting of virgin, effector and memory cells.
- Understanding the mechanisms of signal transduction mediated through antigen receptors, cytokine receptors or inhibitory/costimulatory molecules.

Skills:

- Learning to isolate cells belonging to the immune system, by using different techniques. Management and adjustment of cell concentrations. Measuring cell viability.
- Learning some of the simpler techniques used in the purification of different cell populations.
- To describe and interpret histological samples and pictures of lymphoid organs.
- To acquire the ability of using laboratory techniques aimed to define the proportion of the different leukocyte populations in a healthy individual.
- To acquire the ability of using laboratory techniques to reveal the degree of cellular functionality.

Competencies:

- To be able of linking Immunology to other disciplines of Health and Experimental Biosciences.
- To predict whether the specific innate immune system will be able of recognizing a microorganism invasion and to determine the effector mechanisms leading to the infection curing.
- To predict the cooperation of the different compartments of the immune system in eliminating various microorganisms.
- To develop the capacity for analysis and resolution of immunological problems.
- To acquire the ability to integrate the different mechanisms used by the immune response.
- Team working to solve problems and laboratory practices.
- To develop critical thinking.
- To demonstrate motivation for quality.

CONTENTS

Theoretical and practical contents (2015-16)

Lectures

The contents of this subject are divided into five thematic sections, blocks or units, containing 3-4 themes (lessons) each:

UNIT 1 (B1). Concepts. Molecules, cells and tissues of the immune system. Ontogeny.

Lesson 1 (T1).- Location of Immunology in time. Immunology definition. Basic concepts and general aspects. Innate immunity and acquired immunity. General properties of the immune system. Immune phylogeny.

Lesson 2 (T2).- Immune System Cells: structural and functional characteristics. Hematopoiesis. Lymphoid cells. Non-lymphoid lineage cells.

Lesson 3 (T3).- leukocyte differentiation markers: CD Nomenclature. T cells: molecular markers of differentiation and activation. B cells: molecular markers of differentiation and activation. NK cells: molecular markers of activation and differentiation. Molecular markers of differentiation in other cells of the immune system: macrophages, granulocytes, mast cells and platelets. Ontogeny of the immune system.

Lesson 4 (T4).- The lymphoid tissue: primary organs. Secondary organs. Lymphocyte recirculation

UNIT 2 (B2). Antibodies (Ab). B cell receptor gene rearrangement. Antigen (Ag). Ag-Ab reaction.

Lesson 5 (T5).- antigen receptors of B cells: Immunoglobulins. Isotypes, allotypes and idiotypes. General functions of immunoglobulins: primary and secondary immune response. Biological properties of different types of inmunogobulins: relationship between structure and function of the B cell receptor (BCR).

Lesson 6 (T6).- Genetics of immunoglobulins. Theories about the formation of antibodies. Immunoglobulin genes. Mechanism of genetic rearrangement. Importance of conserved sequences. Enzymes involved. Rearrangement process regulation. Signal sequence recombination (SSR). Isotype switching. Generation of diversity and affinity maturation of immunoglobulins. Synthesis of immunoglobulins: allelic exclusion phenomenon. Secreted immunoglobulins vs. membrane immunoglobulins.

Lesson 7 (T7).- Antigens: Definition and physicochemical characteristics. Immunogen, hapten, adjuvant, epitope/antigenic determinant. Immunogenicity. Mitogens. Superantigens. Antigen-antibody interaction: The spatial complementarity.

UNIT 3 (B3). Major histocompatibility complex (MHC). T-cell receptors. Phagocytic cells and NK cells receptors. Antigen presentation.

Lesson 8 (T8).- The Major Histocompatibility Complex: HLA/MHC system. Importance. Molecular structure and function. Structure, distribution and function of HLA class I and class II. Genetic organization and pattern of inheritance. Antigen processing. Nature of the processed peptide: intracellular vs. extracellular peptides.

Lesson 9 (T9).- T cell antigen receptor (TCR) structure. TCR structure and gene distribution. Rearrangement and gene regulation of TCR. Intrathymic selection: importance of αβ and γδ receptors in the recognition of self. Theory of clonal selection. Functions assigned to TCR-αβ type populations of T cells. CD4+ and CD8+ T lymphocytes. Functions assigned to TCR-γδ type populations of T cells.

Lesson 10 (T10).- Receptor types in granulocytes. Receptors types of cells of the monocyte/macrophage system. Types of NK cell receptors. Functions assigned to each of these leukocyte populations.

Lesson 11 (T11).- Presentation of antigen. Immunological synapse. Lymphocyte activation. The role of co-receptors and other accessory molecules. Biochemical cascade of lymphocyte activation. Second messengers. Protein phosphorylation. Transcription factors. Lymphocyte activation and differentiation of T helper and T cytotoxic (CTL), B and NK cells.

UNIT 4 (B4). Adhesion molecules. Complement system. Cytokines.

Lesson 12 (T12).- Adhesion molecules in the immune response. Classification: integrins, selectins, supergene family of immunoglobulins, cadherins, other molecules. General and specific functions of different families. Control of the expression of adhesion molecules in cells and tissues.

Lesson 13 (T13).- The Complement System. Beginning of activation: Classical, Alternative and lectins pathways. Complement protein biosynthesis. Biological functions of complement. Effector molecules. Complement-mediated cytotoxicity concept. Regulatory molecules. Cellular receptors for the complement. Genetics of Complement.

Lesson 14 (T14).- soluble mediators of immune responses (cytokines): chemical structure and cellular systems producing cytokines. Th1/ c1, Th2/Tc2, Th3 and Th17 cell patterns. Mechanisms of action of cytokines. Classification of cytokines. The pleiotropy of cytokines. Cellular receptors for cytokines. Brief mention of the use of cytokines and their antagonists in Clinics.

UNIT 5 (B5). Cellular immune response. Humoral immune response. Regulatory molecules and cells of the immune response. Regulatory mechanisms. Main immunological diseases.

Lesson 15 (T15).- Humoral immune response: cells and molecules involved. Cellular immune response: cells and molecules involved. Concepts: Cell Cytotoxicity. Antibody dependent cytotoxicity (ADCC).

Lesson 16 (T16).- Regulation of the immune response. Antigens as basic factors controlling the immune response. The feedback effect exerted by antibodies and immune complexes. Idiotypic interactions. Cytokines and regulatory cells. Neuroendocrine Modulation of the immune response. Other regulatory mechanisms: genetic, nutritional, pharmacological.

Lesson 17 (T17).- Hypersensitivity reactions. Definition. Gell and Coombs classification. Concepts: tolerance, autoimmunity and autoimmune disease.

Lesson 18 (T18).- immunodeficiencies. Concept. Classification. Diagnosis and treatment.

Laboratory practices:

1. Separation of peripheral blood mononuclear cells (PBMNc) by density gradient centrifugation.

2.- PBMNc cell count in Neubauer chambers. Cell viability. Visualization by light microscopy and phase contrast identification.

3. Separation of CD4+ and CD8+ lymphocyte populations by using immunospheres. Concept of positive and negative selection. Optical microscopy visualization of the labeled and unlabeled populations.

4.- Obtaining macrophages/ endritic cells from PBMNC, by plastic adherence technique. Viewing through the inverted microscope.

5. Direct and indirect immunofluorescence (IFI) techniques. Counting of T, B and NK lymphocyte subsets by fluorescence microscopy.

6. Phagocytic cells functional assay. Phagocytosis of Candida albicans.

7. Phagocytic cells functional assay. NBT-test.

8. Histology of primary and secondary lymphoid organs: thymus, spleen and lymph nodes. H & E staining.

EVALUATION

Instruments and criteria of Evaluation 2015-16

Attendance will be voluntary for lectures, seminars and tutoring in groups but obligatory for lab practices (have to attend at least 80%); only in exceptional and duly justified cases, students who do not meet this minimum requirement of 80% or that for professional reasons declare having acquired the skills of the internship program of the course, and again according to the professor, there will be the possibility of a Lab practices review which will consist of both a written test about the content of the different practices developed throughout thet program and a manual part including the successful completion and explanation (step by step) of one of the laboratory techniques handled in practice, with an oral presentation of the results thereof.

The written/oral tests relating to Lectures, Lab practices, Tutoring in groups and Seminars/ presentations, as well as teacher comments, are part of the continuous assessment that will represent a 50% of the course grade, pondered between the different activities (see table). The corresponding continuous assessment marks will be maintained for two academic years. The written exam or final test on the theoretical and practical aspects remains the other 50% of the grade.

The written tests consist of multiple choice questions (MCQs) (50%) and/or 1-5 short open questions (PRAC) (50%), and may include both questions in lectures and practical classes. For the first call of the course, the final grade will consist of the mark obtained in the final test and the one obtained in the continuous assessment, only in the case of having obtained at least 4 (out of 10) in the corresponding mark of the final test.

In the second call of the subject and in subsequent calls, the student will only perform the final written test on the theoretical/practical content, which will constitute 50% of the mark, to which must be added the one obtained from continuous assessment.

For calls of the next academic year, students may choose between repeating the entire continuous assessment or keeping the mark of continuous assessment obtained in the previous year.

Students applying for the extraordinary evaluation for completion of studies (December), will keep the mark obtained in the continuous assessment of the course immediately before and will take the final written test on the theoretical/practical content. The value of each part is the same as in ordinary calls. In cases where the student does not have a mark of continuous assessment, will take a separate test that will consist in development and oral exposure (step by step) in the laboratory of practices, of one of the laboratory techniques enclosed in the program. They will also perform a review on one of the themes included in the program or on a current issue in the field (in agreement with the teacher responsible for the course), which will be presented orally.

Type	Criterion	Description	Ponderation
FINAL TEST	The written test will consist of multiple choice questions (MCQs) (50%) and/or 1-5 short open questions (PRAC) (50%), and may include both questions in lectures and practical classes. The final score will comprise the mark obtained in the final test and the one obtained in the continuous assessment, only in the case of having obtained at least 4 (out of 10) in the corresponding mark of the final test.	FINAL EXAM	50

ACTIVITIES OF EVALUATION DURING THE SEMESTER	**Oral/Written theoretical and practical tests: 30%** To answer orally to general questions about the subject in class and/or Lab practices. To respond in writing to questionnaires on the subject in class and/or Lab practices (two or three questionnaires will be carried out throughout the course, distributed among the theoretical and practical classes): 20% Notebook of practices: 10% **Comments from the Teacher and Tutoring: 5%** Attitude, degree of participation, interest and student achievement in the various activities of the program; participation in on-line discussions; acquisition of practical skills. Putting queries and solving problems/ questions related to the subject. **Seminars and Oral/Written presentations: 15%** Seminars in small groups using PBL (Problem Based Learning) techniques. Oral presentation and defense of a current issue related with Immunology or a lesson from the program, either individually or in small groups.	Oral/Written theoretical and practical tests. Comments from the teacher. Seminars and Oral/Written presentations. Tutoring in groups.	50