COURSE GUIDE

# Immunology

Last updated date: 18/06/2021
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| Grado (Bachelor's Degree) | Bachelor's Degree in Pharmacy | Branch | Health Sciences |
| Module | Medicina y Farmacología | Subject | Inmunología |

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| Year of study | 3º | Semester | 1º | ECTS Credits | 6 | Course type | Compulsory course |

## PREREQUISITES AND RECOMMENDATIONS

- It is recommended that the students have completed the following subjects: Structural Biochemistry, Metabolic Biochemistry, Cellular and Human Physiology I and Cellular and Human Physiology II.
- Students must have an appropriate knowledge of English to understand scientific texts.

## BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

- Molecular and cellular basis of the Immune System.
- Mechanisms of the immune response.
- Human molecular immunopathology.
- Physiopathology of immunological disorders.
- Drugs of immunological origin.
- Basic immunological techniques.

## SKILLS

### GENERAL SKILLS

- CG01 - Identificar, diseñar, obtener, analizar, controlar y producir fármacos y medicamentos, así como otros productos y materias primas de interés sanitario de uso humano o veterinario.
- CG02 - Evaluar los efectos terapéuticos y tóxicos de sustancias con actividad farmacológica.
- CG03 - Saber aplicar el método científico y adquirir habilidades en el manejo de la legislación, fuentes de información, bibliografía, elaboración de protocolos y demás aspectos que se consideran necesarios para el diseño y evaluación crítica de ensayos preclínicos y clínicos.
- CG05 - Prestar consejo terapéutico en farmacoterapia y dietoterapia, así como en el ámbito nutricional y alimentario en los establecimientos en los que presten servicios.
- CG09 - Intervenir en las actividades de promoción de la salud, prevención de

enfermedad, en el ámbito individual, familiar y comunitario; con una visión integral y multiprofesional del proceso salud-enfermedad.
- CG10 - Diseñar, aplicar y evaluar reactivos, métodos y técnicas analíticas clínicas, conociendo los fundamentos básicos de los análisis clínicos y las características y contenidos de los dictámenes de diagnóstico de laboratorio.

### SUBJECT-SPECIFIC SKILLS

- CE36 - Conocer y comprender los fundamentos básicos de los análisis clínicos y las características y contenidos de los dictámenes del diagnóstico de laboratorio.
- CE38 - Evaluar los efectos de sustancias con actividad farmacológica.
- CE39 - Conocer y comprender las técnicas utilizadas en el diseño y evaluación de los ensayos preclínicos y clínicos.
- CE42 - Adquirir las habilidades necesarias para poder prestar consejo terapéutico en farmacoterapia y dietoterapia, así como consejo nutricional y alimentario a los usuarios de los establecimientos en los que presten servicio.
- CE46 - Conocer las propiedades y mecanismos de acción de los fármacos.
- CE47 - Conocer y comprender la estructura y función del cuerpo humano, así como los mecanismos generales de la enfermedad, alteraciones moleculares, estructurales y funcionales, expresión sindrómica y herramientas terapéuticas para restaurar la salud.
- CE49 - Conocer las Técnicas analíticas relacionadas con diagnóstico de laboratorio, tóxicos, alimentos y medioambiente.

### TRANSFERABLE SKILLS

- CT02 - Capacidad de utilizar con desenvoltura las TICs

## LEARNING OUTCOMES

- To know the elements, cells and organs of the Immune System.
- To know and understand the types of immune response and the effector and regulatory mechanisms involved in them.
- To know the mechanisms involved in the most common diseases of the Immune System.
- To know the main drugs which modulate the immune response and the role of Immunology in pharmaceutical research and development.
- To learn the basic immunological techniques used in research and diagnostic laboratories.

## PLANNED LEARNING ACTIVITIES

### THEORY SYLLABUS

- 1. Introduction to Immunology. Components of the Immune System. Types of immune response. Features of the innate and adaptive immune responses. Clonality and memory in the immune response.
- 2. Hematopoiesis. Hematopoietic stem cells. Hematopoietic regulation by apoptosis. Hematopoietic differentiation.
- 3. Organs of the Immune System. Structure and function of the primary and secondary lymphoid organs. Lymphocyte homing and recirculation.

- 4. Immunogenicity and antigenicity. Antigens. Epitopes. Haptens. Adjuvants.
- 5. Immunoglobulin structure. Variable, hypervariable and constant regions. Isotypes. Three-dimensional structure of immunoglobulins.
- 6. Biological properties and functions of immunoglobulins.
- 7. Molecular genetics of immunoglobulins. Recombination and recombinases. Generation of antibody diversity.
- 8. Differentiation and maturation of B lymphocytes. Expression and regulation of immunoglobulin genes during B-cell development in the bone marrow. B-cell selection.
- 9. Monoclonal antibodies. Production. Diagnosis and therapeutic applications.
- 10. The major histocompatibility complex. Classes of HLA molecules. Structure of HLA antigens. Genetic organization of MHC. HLA polymorphism.
- 11. Antigen processing and presentation. Cytosolic and endocytic pathways. Antigen-presenting cells. MHC restriction.
- 12. The T-cell receptor (TCR). Structure of the TCR/CD3 complex. TCR alpha/beta and TCR gamma/delta. Organization and rearrangement of T-cell receptor genes. Generation of TCR diversity.
- 13. Differentiation and maturation of T lymphocytes in the thymus. Generation of central tolerance. Positive and negative selection.
- 14. T-cell activation. Intracellular signalling pathways activated by the TCR. Accessory molecules and costimulatory signals. Superantigens.
- 15. B-cell activation. The B-cell receptor (BCR) and the B-cell co-receptor. B-cell response to thymus-dependent and thymus-independent antigens. Changes in the structure and function of antibodies during the immune response.
- 16. Cytokines. General features and biological properties. Th1, Th2 and Th17 cytokines: generation and function.
- 17. Mechanisms of immunosuppression. Generation of peripheral tolerance. Anergy. Regulatory T cells.
- 18. The complement system I. Three pathways of complement activation: the alternative, the lectin and the classical pathways.
- 19. The complement system II. Regulation of the complement system. Effector functions of complement. Complement deficiencies.
- 20. The inflammatory response I. Phases of inflammation. First stage of the inflammatory response. Mast cells and basophils. Inflammatory mediators.
- 21. The inflammatory response II. Immune cells migration in inflammation. Chemokines and their receptors. Interaction between leukocytes and endothelial cells. Adhesion molecules. Neutrophils and macrophages.
- 22. The inflammatory response III. Acute-phase proteins. Pro-inflammatory cytokines. Chronic inflammation. Mechanisms regulating inflammation and tissue repair.
- 23. Receptors of the innate immunity. Pathogen-associated molecular patterns. Pattern recognition receptors: Families of receptors.
- 24. Effector mechanisms of cell-mediated immunity. Characteristic of effector and memory T cells. Mechanism of cytotoxicity. Cytotoxic T lymphocytes (CTL). Introduction to innate lymphoid cells.
- 25. NK cells. The lytic function of NK cells. Activating and inhibitory NK cell receptors. Antibody dependent cell-mediated cytotoxicity (ADCC).
- 26. Immunological diagnostic techniques. Immunological methods based on antigen-antibody interaction. Functional assays.
- 27. Integration of innate and adaptive immune responses. The immune response against pathogens.
- 28. Vaccines. Passive and active immunization. Types of vaccines.
- 29. Hypersensitivity reactions. Types. Immediate or type I hypersensitivity. Type II (antibody-mediated). hypersensitivity. Immune complex-mediated type III hypersensitivity. Delayed type hypersensitivity (Type IV). Diseases associated with hypersensitivity reactions.

- 30. Autoimmunity. Mechanisms of autoimmunity. Factors involved in the development of autoimmunity. Autoimmune diseases and therapeutic strategies.
- 31. Primary immunodeficiencies. Types. Features. X-linked and autosomal primary immunodeficiencies.
- 32. Secondary immunodeficiencies. Acquired immunodeficiency syndrome. Mechanisms of HIV replication and destruction of the immune system. Immune response against HIV.HIV therapeutic and prevention approaches.
- 33. Transplants. Types of transplants. Transplant rejection. Types of rejection. Graft-versus-host disease. Transplant immunopharmacology.
- 34. Cancer and immune system. Tumor antigens. Mechanisms responsible for tumor evasion. Cancer immunotherapy.

### PRACTICAL SYLLABUS

- Identification of lymphoid organs and extraction of lymphocytes. Phagocytosis assay with peritoneal macrophages.
- Protein immunodetection. Dot-blotting.
- Flow cytometry. Detection of membrane antigens.
- Complement-mediated cytotoxicity: serological typing of HLA I.

## RECOMMENDED READING

### ESSENTIAL READING


- A.K. Abbas, A.H. Lichtman and S. Pillai. Cellular and Molecular Immunology, 9th ed. Elsevier, 2017. (*)
- A.K. Abbas, A.H. Lichtman and S. Pillai. Basic Immunology: Functions and Disorders of the Immune System, 6th ed. Saunders, 2019. (*)
- H. Chapel, M. Haeney, S. Misbah and N. Snowden. Essentials of Clinical Immunology, 6th ed. Wiley Blackwell, 2014.
- Coligan J.E., Bierer B.E. Current Protocols in Immunology. Wiley, 2016.
- J.M. Cruse and R.E. Lewis, Illustrated Dictionary of Immunology, 3rd ed. CRC Press, 2009.
- P.J. Delves, S. Martin, D. Burton and I. Roitt. Roitt's Essential Immunology, 13th ed. Wiley-Blackwell, 2017. (*)
- A.H. Lichtman, R. Malhotra, and V. Taqueti. Review of Immunology. W.B. Saunders Co., Philadelphia, 2005.
- D. Male, J. Brostoff, D. Roth and I. Roitt. Immunology, 8th ed. Saunders, 2012. (*)
- T.W. Mak and M.E. Saunders. The Immune Response: Basic and Clinical Principles. Elsevier Academic Press, 2006.
- K.P. Murphy and C. Weaver. Janeway's Immunobiology, 9th ed. Garland Science, 2016. (*)
- J. Punt, S. Stranford, P. Jones and J.A. Owen. Kuby Immunology, 8th ed. Freeman 2019. (*)
- P. Parham. The Immune System, 4th ed. Garland Science, 2014. (*)
- W. E. Paul. Fundamental Immunology, 7th ed. Lippincott Williams & Wilkins, Philadelphia, 2012.
- A. Rabson, I. Roitt and P. Delves. Really Essential Medical Immunology, 2nd ed. Blackwell Publishing, Oxford, 2004.
- H.D. Zane. Immunology: Theoretical & Practical Concepts in Laboratory Medicine. W.B. Saunders Co, Philadelphia, 2001.


### COMPLEMENTARY READING

- Cell
- Current Opinion in Immunology
- Immunity
- Immunological Reviews
- Nature Immunology
- The Journal of Immunology
- Trends in Immunology

## RECOMMENDED LEARNING RESOURCES/TOOLS

- http://www.cellsalive.com/toc_immun.htm
- http://www.bioinf.org.uk/abs/
- http://www.complement-genetics.uni-mainz.de/
- http://stke.sciencemag.org/
- http://www.rndsystems.com/research_topic.aspx?r=4
- http://www.nature.com/ni/multimedia/index.html
- http://www.immunology.utoronto.ca/immunology-videos

## TEACHING METHODS

- MD01 Lección magistral/expositiva
- MD04 Prácticas de laboratorio y/o clínicas y/o oficinas de Farmacia
- MD07 Seminarios
- MD09 Realización de trabajos en grupo
- MD10 Realización de trabajos individuales
- MD12 Tutorías

## ASSESSMENT METHODS (Instruments, criteria and percentages)

### ORDINARY EXAMINATION DIET

- Multiple-choice, essay or short-question exams to assess the theoretical and practical knowledge acquired. They will account for 70% of the student's final mark. In the middle of the semester, a follow-up test will be carried out, which will allow to eliminate the evaluated topics if the mark is equal to or higher than 6.5 points (out of 10). A minimum mark of 4 (out of 10) in the final average exam mark is required for the rest of the marks to be added to this one. In the case of multiple-choice exams, each question will have 5 possible answers and for each incorrect answer a quarter of the mark corresponding to a correct answer will be subtracted.
- Academically supervised works. The student's original work will be evaluated, taking into account the adequacy to the proposed topic, its development, methodology, results, bibliography and conclusions; as well as the ability of comprehension and the written presentation. It will represent 10% of the final mark.
- Seminars. Individual and/or group work will be assessed, taking into account the suitability to the proposed topic, its development, methodology, results, bibliography and conclusions; as well as the capacity for comprehension and presentation both in written and oral form. It will account for 15% of the final mark.
- Practical work. The skills and competences acquired by the student will be evaluated by

means of a practical work questionnaire. It will account for 5% of the final mark.

## EXTRAORDINARY EXAMINATION DIET

- Multiple-choice, essay or short-question exams to assess the theoretical and practical knowledge acquired. They will account for 70% of the student's final mark. A minimum mark of 4 (out of 10) in the final average exam mark is required for the rest of the marks to be added to this one. In the case of multiple-choice exams, each question will have 5 possible answers and for each incorrect answer a quarter of the mark corresponding to a correct answer will be subtracted.
- The mark of the complementary activities (practical questionnaire, supervised individual work and seminar) carried out during the course will be added, weighted according to the percentages indicated above (5% practical questionnaire, 10% directed work and 15% seminar), thus accounting for the remaining 30% of the final mark.
- In order to guarantee the possibility of obtaining 100% of the final mark in the extraordinary assessment session, in accordance with article 19 of the assessment regulation of the UGR, students who have not completed or passed the complementary activities, that is, that do not reach 50% of the final mark (1.5 out of 3) may submit a work on the day of the exam, the subject and content of which will be announced at least 7 days in advance. This work will account for 30% of the student's final mark.

## SINGLE FINAL ASSESSMENT (evaluación única final)

- Multiple-choice, essay or short-question exams to assess the theoretical and practical knowledge acquired. They will account for 95% of the student's final mark. In the case of multiple-choice exams, each question will have 5 possible answers and for each incorrect answer a quarter of the mark corresponding to a correct answer will be subtracted.
- Practical work questionnaire. It will account for 5% of the final mark.