

Approval date: 22/06/2023

COURSE GUIDE

**Immunology (2041134)**

<b>Grado (Bachelor's Degree)</b>	Grado en Farmacia		<b>Branch</b>	Health Sciences			
<b>Module</b>	Medicina y Farmacología		<b>Subject</b>	Inmunología			
<b>Year of study</b>	3 <sup>o</sup>	<b>Semester</b>	1 <sup>o</sup>	<b>ECTS Credits</b>	6	<b>Course type</b>	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 oral and written English to adequately follow classes and to prepare oral presentations and essays and answer questions in exams.

**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).
- 25. NK cells. The lytic function of NK cells. Activating and inhibitory NK cell receptors. Antibody dependent cell-mediated cytotoxicity (ADCC). Introduction to innate lymphoid cells.
- 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 Class I antigens.

## RECOMMENDED READING

### ESSENTIAL READING

- A.K. Abbas, A.H. Lichtman and S. Pillai. Cellular and Molecular Immunology, 10th ed. Elsevier, 2021. (\*)
- A.K. Abbas, A.H. Lichtman and S. Pillai. Basic Immunology: Functions and Disorders of the Immune System, 6th ed. Elsevier, 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, R.S. Peebles and V. Male. Immunology, 9th ed. Elsevier, 2020. (\*)
- T.W. Mak and M.E. Saunders. The Immune Response: Basic and Clinical Principles. Elsevier Academic Press, 2006.
- K.P. Murphy C. Weaver and L.J. Berg. Janeway's Immunobiology, 10th ed. W W Norton & Co Inc, 2022. (\*)
- J. Punt, S. Stranford, P. Jones and J.A. Owen. Kuby Immunology, 8th ed. Freeman 2019. (\*)
- P. Parham. The Immune System, 5th ed. W W Norton & Co Inc, 2021. (\*)
- 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.cellalive.com/toc\\_immun.htm](http://www.cellalive.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.rndsystems.com/research_topic.aspx?r=4)
- <http://www.nature.com/ni/multimedia/index.html>
- <http://www.immunology.utoronto.ca/immunology-videos>
- <https://accessmedicina.mhmedical.com/Book.aspx?bookid=2951>

**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 4,5 (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.
- **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. Failure to present the written script and/or the oral presentation on the day agreed by the teacher will mean one point less in the student's final mark.



- **Attendance at seminars.** Attendance will be assessed, as well as the student's participation, contributions and attitude in the seminar sessions. It will account for 5% of the final mark.
- **Practical work.** Completion of the practical work will be compulsory in order to pass the course. The skills and competences acquired by the student will be evaluated by means of a practical work questionnaire, which could be an online questionnaire. It will account for 10% of the final mark. The students who have passed the practical work are not obliged to repeat it in the following two years, but in this case the mark obtained is not kept. Therefore, they must retake the questionnaire to obtain the corresponding 10% 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 4,5 (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, seminar and attendance at seminars) carried out during the course **will be added**, weighted according to the percentages indicated above (10% practical questionnaire, 15% seminar and 5% attendance at seminars), 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 an essay** on the day of the exam, the subject and content of which will be announced at least 7 days in advance. This essay will account for 30% of the student's final mark. The presentation of this essay will annul the previous mark of the complementary activities.

### 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 90% 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 10% of the final mark.

### ADDITIONAL INFORMATION

- According to article 6.2 of the assessment regulation of the UGR, the evaluation will be preferably continuous, understanding as such the diversified evaluation established in this Teaching Guide, both in the ordinary and the extraordinary call. However, a **single final assessment** is envisaged for those students who are unable to comply with the continuous assessment method due to work-related reasons, health condition, disability, mobility programmes or any other duly justified reason. In order to make use of the single final assessment, the student will follow the indications described in article 8.2 of the aforementioned regulations.
- In accordance with article 15 of the assessment regulations of the UGR, and endorsed by





the Code of Ethics of the UGR, **plagiarism** in the completion of any of the assignments or tests will automatically lead to a numerical mark of zero in the subject, regardless of the rest of the marks that the student has obtained.

- In accordance with article 9 of the assessment regulations of the UGR, in case of **special incidences** due to exceptional and justified reasons that prevent the student from attending the day of the exam, he/she will have to request an incidence exam to the director of the department through the electronic office and, once granted, will agree with the professor another date for the exam. The system, criteria and weighting of the mark will be identical to that described above.

