

**COURSE DATA****Data Subject**

|                      |                                      |
|----------------------|--------------------------------------|
| <b>Code</b>          | 34090                                |
| <b>Name</b>          | Clinical Biochemistry and Hematology |
| <b>Cycle</b>         | Grade                                |
| <b>ECTS Credits</b>  | 6.0                                  |
| <b>Academic year</b> | 2022 - 2023                          |

**Study (s)**

| <b>Degree</b>  | <b>Center</b>                         | <b>Acad. year</b> | <b>Period</b> |
|--|---------------------------------------|-------------------|---------------|
| 1201 - Degree in Pharmacy  | Faculty of Pharmacy and Food Sciences | 4                 | Second term   |
| 1211 - Double Degree in Pharmacy and Human Nutrition and Dietetics | Faculty of Pharmacy and Food Sciences | 4                 | Second term   |

**Subject-matter**

| <b>Degree</b>  | <b>Subject-matter</b>  | <b>Character</b> |
|--|--|------------------|
| 1201 - Degree in Pharmacy  | 24 - Clinical analysis and laboratory diagnostics                          | Obligatory       |
| 1211 - Double Degree in Pharmacy and Human Nutrition and Dietetics | 1 - Asignaturas obligatorias del PDG Farmacia-Nutrici3n Humana y Diet3tica | Obligatory       |

**Coordination**

| <b>Name</b>               | <b>Department</b>                       |
|---------------------------|---|
| ESTORNELL RAMOS, ERNESTO  | 30 - Biochemistry and Molecular Biology |
| SASTRE BELLOCH, JUAN JOSE | 190 - Physiology                        |

**SUMMARY**

The matter comprises part of the vast field of the biological analyses applied to the diagnostic and follow-up of the human illnesses. It is divided in two areas of knowledge: Clinical Biochemistry and Hematology.

The Clinical Biochemistry is an applied science that accomplishes the study of the biochemical alterations that the illness triggers in the maintenance of the homeostatic constants. For this, it is



supported by tests of laboratory that allow us understand the true operation of organs and systems, discern the pathological variations and help, therefore, to the diagnostic, prognosis, control of the evolution, treatment, monitoring of drugs and prevention of the illness.

The Hematology addresses the study of the diagnostic of the pathological processes that produce alterations in the diverse types of blood cells, comprising so much the diagnostic of the different anemia as well as poliglobulies, thrombotic phenomena and alterations of the leucocytes.

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

It is specially recommended to demonstrate previous knowledge corresponding to the subjects of Biochemistry I, Biochemistry II, Physiology and Physiopathology, in addition to instrumental methods and techniques, to obtain the own level of conceptual understanding of the subject, in addition to the obvious knowledge of the basic matters, like chemistry, physics, mathematics and biology.

## COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

### 1201 - Degree in Pharmacy

- To possess and to understand the knowledge in the different areas of study included in the formation of the pharmacist.
- To apply this knowledge to the professional world, contributing to the development of Human Rights, democratic principles, principles of equality between women and men, solidarity, protection of the environment and promotion of a culture of peace with Gender perspective.
- To know how interpret, value and communicate relevant data in the different aspects of pharmaceutical activity, making use of information and communication technologies.
- Skill to communicate ideas, analyze problems and solve them with a critical mind, achieving team-working abilities and assuming leadership whenever required.
- Development of skills to update their knowledge and undertake further studies, including pharmaceutical specialization, scientific research and technological development, and teaching.
- Training in debate and rationally based criticism.
- Designing, implementing and evaluating reagents, clinical analytical methods and techniques, knowing the basics of clinical analyses and the nature and contents of laboratory diagnostic reports.



- Develop health and hygiene analyses
- Master the analytical terminology in clinical chemistry and haematology
- Know and understand the basis of the methods and technique used in clinical chemistry and haematology for the diagnosis of occupational diseases and the basis of their application.
- To know and to develop the necessary techniques in clinical chemistry and haematology for proper processing of any biological sample that may be analysed in a laboratory of clinical chemistry and haematology.
- To know the diagnostic utility of each method and technique in clinical chemistry and haematology, valuing what is your specific use, the prognostic value and the complementary test that requires, considering the gender bias in the clinical diagnoses.
- Know and handle with the documentary sources of Clinical Biochemistry and haematology within the field of diagnosis of human diseases.
- Training in addressing analytical results in an interdisciplinary manner with other professionals.
- Development of future professional awareness based on the relevance of the diagnosis made.

### **LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)**

The fundamental result of learning is to train future pharmacists in the field of laboratory analytics applied to the diagnosis and monitoring of human diseases, especially those of metabolic, degenerative and nutritional origin. Specifically, this training will delve into the methodological and technical aspects that will allow them the correct performance and interpretation of laboratory tests. The selection of topics for each of the disciplines specified in the following sections specifies, clarifies and outlines these general objectives.

Each one of the modules of the asignatura presents his particular thematic program, in which has followed like main criterion a careful selection that will allow to the alumnado have a sufficiently wide vision of the extensive field of the diagnostic proofs laboratory, but focusing on those aspects that, due to their frequency or relevance, require a greater knowledge of the student for further professional development. All this, trying that, from particular cases, the students draw conclusions, procedures and general operative ways that can later apply to those aspects that have been left out of the agenda or have been addressed more generally.

After having taken this subject, students must be able to: master analytical terminology in all its fields; acquire and develop the relevant skills for proper handling of all inventoryable and expendable material for use in the field of diagnosis; understand the basics of the methods and techniques used in the diagnosis of diseases and the fundamentals of their application; master the techniques necessary for proper processing of any biological sample that can be analyzed in a clinical analysis laboratory; to know the diagnostic utility of each method and technique, valuing what is its concrete use, the prognostic value and the complementary tests that it requires; to know and to handle with criterion the documentary sources of all type within the field of the diagnosis of the human diseases. In addition it is necessary to emphasize the attainment of the capacity for the well-founded argumentation and the rational critic, the capacity to be able to approach the resolution of the analytical one of interdisciplinary form with other professionals and the development of the conscience, in a professional future, of the relevance of the



diagnosis to be made.

All these objectives are framed within the Sustainable Development Goals (SDGs), which will be present in the subject of both theoretical and practical classes, especially with reference, whenever appropriate, to the global health situation and inequalities. existing in access to diagnostic and prevention tests, as well as to the improvement of the quality of life of the general population through early diagnosis. On the other hand, environmental sustainability will be present, with awareness in the optimization of resources, the reduction of possible waste and, above all, the reduction of waste that can be environmental pollutants. Both approaches will be brought together to contribute to the growth of awareness that will make a new social model possible.

## DESCRIPTION OF CONTENTS

### 1. Diagnosis of laboratory of the alterations of the red series

- General aspects of the diagnostic of anemia.
- Diagnostic of laboratory of the ferropenic anemia.
- Diagnostic of laboratory of the megaloblastic and aplasic anemia.
- Diagnosis of laboratory of the hemolytic anemia. Hemoglobinopathia.
- Diagnosis of laboratory of polyglobulia.

### 2. Diagnosis of laboratory of the alterations of hemostasia

- Diagnosis of laboratory of the hemorrhagic diathesis.
- Diagnosis of laboratory of the thrombosis and control of the patient with thrombotic phenomena.

### 3. Diagnosis of laboratory of the alterations of the white series

- Diagnosis of laboratory of the quantitative alterations of the leukocytes.
- Diagnosis differential of the leucocytosi.
- Diagnosis differential of leucopenia.
- Diagnosis of laboratory of the qualitative alterations of the leukocytes.
- Diagnosis of laboratory of leukemia and the mielodisplasic syndromes.

### 4. Laboratory of Hematology

- Differential hematologic analyzer. Count of reticulocytes.
- Sideremia. Index of hemolysis.
- Leukocyte Formula.
- Coagulation.



### **5. Concepts and interpretation of results in Clinical Biochemistry**

Reference population. Decisive values and reference intervals. Interpretation of results. Biomarkers. Distributions of values in populations. Diagnostic sensitivity and specificity. Predictive value of biochemical determinations. ROC curves and comparisons. Limitations of tumor markers.

### **6. Evaluation and alterations of glycid metabolism**

Glycid metabolism: Main causes of alteration. Selection of analytes. Methods and analytical techniques. Differential diagnosis of Diabetes mellitus and hypoglycemia.

### **7. Alterations and evaluation of plasma lipoproteins**

Alterations and evaluation of plasma lipoproteins. Characteristics, origin, function and destiny of plasma lipoproteins. Main alterations of the lipid transport. Methods and analytical techniques. Biochemical diagnosis of hypo- and hyperlipoproteinemias. Evaluation of the aterogenic risk.

### **8. Alterations and evaluation of nitrogen metabolism**

Alterations and evaluation of nitrogen metabolism. Application to the diagnosis of the renal excretion function. Urea, creatinina and proteinurias. Alterations in purine bases metabolism. Biochemical evaluation of hyperuricemias. Analytical methods and techniques.

### **9. Alterations and evaluation of the bone and mineral metabolism**

Alterations and evaluation of the bone and mineral metabolism. Main mineral elements and their hormonal control. Diagnostic implications. Analytical methods and techniques.

### **10. Clinical Enzymology**

Clinical Enzymology. Origin, half-life and plasma concentration. Diagnostic value of enzymes and isoenzymes. Analytical methods and techniques. Interpretation of results of enzyme panels.

### **11. Plasma proteins.**

Main plasma proteins used in Clinical Biochemistry. Functions, metabolism and diagnostic utility. Methods and techniques of analysis. Main tumor markers.

**12. Clinical Biochemistry Laboratory**

Determination of metabolites:

Glucose

Triacylglycerols

Cholesterol

HDL-cholesterol: lipid balance, evaluation of atherogenic risk

Urea

Creatinine

Proteins

Enzyme activity determinations of clinical interest:

Aspartate aminotransferase (ASAT)

Alanina aminotransferase (ALAT)

Alcaline phosphatase (ALP)

Gamma-glutamyl transpeptidase (GGT)

**WORKLOAD**

| ACTIVITY                                     | Hours         | % To be attended |
|--|---------------|------------------|
| Theory classes                               | 28,00         | 100              |
| Laboratory practices                         | 25,00         | 100              |
| Tutorials                                    | 3,00          | 100              |
| Seminars                                     | 2,00          | 100              |
| Attendance at events and external activities | 4,00          | 0                |
| Development of group work                    | 4,00          | 0                |
| Preparing lectures                           | 52,00         | 0                |
| Preparation of practical classes and problem | 30,00         | 0                |
| <b>TOTAL</b>                                 | <b>148,00</b> |                  |

**TEACHING METHODOLOGY**

The actual hours of theory, raised as a theoretical and practical classes, teacher explain the problems surrounding the diagnosis of diseases, as well as the basic methodology for the correct processing of all and each one of the biological materials liable to be processed in a laboratory dedicated to the diagnosis of diseases. Meanwhile, the students should take notes from the information received, while they should try to ask all those questions and issues that arise at the time. In actual practice hours, activity in the laboratory focuses on two parts: teacher will present the objectives, will inform about the handling of the material, will oversee the completion of the work and help the interpretation of the results; on the other hand, students will be carried out individually or in pairs, the technical procedure. In the hour of tutoring, the student must raise their needs, while the teacher must guide and resolve doubts; alternately the



teacher will propose questions and problems to be solved under his/her supervision by the students. All this in order to achieve an adequate technical knowledge of the module. Finally, in the review will be raised a number of issues involving single answer but also issues of reasoning which induce the student to reflect and think about the issue.

## EVALUATION

For the evaluation of the learning carried out, the direct verification of the level that the student acquires is considered fundamental, which can be carried out in the set of contact hours, especially and fundamentally with regard to the observation. of the daily work done. This should allow the teacher to directly establish a dynamic image of the evolution of each student throughout the thematic block of each area of knowledge.

However, the numerical qualification of the acquired knowledge and skills must be established on the basis of methods that allow a comparable and objective measurement of the same, with registration of results, which implies the qualification of the written test. In this sense, and by means of global theoretical-practical examination of the asignatura, that will consist so much of questions type test, of questions, of questions of development and of practical suppositions, the student has to evidence the competitions and knowledge acquired.

Taking into account the division of the subject between areas of knowledge, the distribution of the score to be obtained by the student has been made in a weighted way to the content of the subject. Therefore, the following evaluation criteria and rules must be taken into account:

1. The two thematic blocks that comprise the subject, Clinical Biochemistry and Hematology, are evaluated in a single final exam out of a total of **90 points**. In this examination are included and scored in an undifferentiated way both the theoretical contents and the practical contents of the subject. Attendance at practical classes is mandatory for all those students who did not take them in any of the three previous courses.
2. For the final grade, the score obtained in each of the blocks is normalized according to the teaching loads. Thus, the percentage of contribution to the final grade of the 2 thematic blocks will be 40% for Hematology and 60% for Clinical Biochemistry.
3. The subject is approved or suspended globally. To pass the course you must obtain 50% of the total score of the exam (**45 points**) and at least 40% of the score in each of the 2 thematic blocks, according to the following distribution:

|            | Total Score | 50 % | 40 % |
|------------|-------------|------|------|
| Hematology | 35,0        | 17,5 | 14,0 |



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|                       |             |             |      |
|-----------------------|-------------|-------------|------|
| Clinical Biochemistry | 55,0        | 27,5        | 22,0 |
| <b>TOTAL</b>          | <b>90,0</b> | <b>45,0</b> |      |

4. Once you have passed the exam with a score equal to or higher than **45 points** (and at least 40% of the score in both blocks), you can obtain up to a maximum of **10 additional points** (distributed equally between both areas of knowledge) by means of the continuous evaluation by professors of the attitude and the active participation of students in the face-to-face classes, so much theoretical as practical, and of the valuation of the memory of the practical activities. In the case of seminars with oral presentation of topics or other training activities, score will be assessed within these 10 points. These additional assessments will only be applied in those cases in which the examination of the subject has been passed as specified in section 3.

5. The overall grade will be the sum of the weighted scores of the exam as specified in section 3 and the additional assessments specified in section 4, with a total of **100 points** in the overall grade. subject.

6. In the event that in the first call the qualification of suspension has been obtained but one of the blocks is approved with a score equal to or greater than 50% (**17.5 points** for Hematology and **27.5 points** for Biochemistry Clinical), the score will be maintained for the second call within the same academic year, but not if it is less than 50%. Therefore, in this second call it will only be necessary to examine the pending module, but the qualification in the subject will also require compliance with section 3.

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## REFERENCES

### Basic

- Rifai, N., Horvath, R. and Wittwer, C.T. (eds) Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics, 7th ed, Saunders-Elsevier (2019).
- Henry, J.B. (ed) El laboratorio en el diagnostico clínico (Edición homenaje a Todd-Sanford & Davidsohn), Marbán (2017).
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- González Hernández, A. (ed) Principios de bioquímica clínica y patología molecular, 3ª ed, Elsevier (2019).
- Bain, B.J., Bates, I. y Laffan, M.A. (ed) Dacie y Lewis. Hematología práctica, 12ª ed, Elsevier (2018).

#### **Additional**

- Rifai, N., Horvath, R. and Wittwer, C.T. (eds) Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 7th ed, Saunders-Elsevier (2017).
- Kaushansky, K., Lichtman, M.A., Prchal, J.T., Levi, M.M., Burns, L.J. and Linch, D. (eds) Hematology, 10th ed, McGraw Hill (2021).
- Hoffmann, G.F. F., Zschocke, J. and Nyhan, W.L. (eds) Inherited Metabolic Diseases: A Clinical Approach, Springer (2017).
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- Jameson, J.L., Fauci, A., Kasper, D., Hauser, S., Logo, D. y Loscalzo, J. (eds) Harrison Principios de Medicina Interna, 20ª ed, McGraw Hill (2019).