COURSE DATA

DATA SUBJECT

Code: 34448
Name: Biochemical Integration and Clinical Biochemistry
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1204 - Degree in Medicine	Facultat de Medicina i Odontologia	2	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1204 - Degree in Medicine	Biochemistry	BASIC

COORDINATION

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SUMMARY

In recent years, the extraordinary advances and developments in biomedical sciences have greatly enhanced our understanding of human functioning, making the principles that guide it increasingly evident: integration, utilization, and recycling. From a limited number of biomolecules, and thanks to numerous layers of control, flux, and partitioning, our organism can synthesize and use an enormous diversity of metabolites that enable its functioning and adaptation to different physiological and pathological conditions. Thus, integrating the basic knowledge of biochemistry and molecular biology into the human organism is essential to understand our healthy or ill functioning (basic interest) and to analyze potential responses to nutritional or pharmacological interventions (applied interest).

Molecular biology, along with clinical biochemistry and their integration in the human body, constitute a fundamental area of medicine where significant advances with technological and social impact are made. The course on Biochemical Integration and Clinical Biochemistry, highlights the importance of the molecular level in the modern clinical context and aims to provide future doctors with the knowledge, attitudes, and skills to place them at an advantage in a formative, scientific, and professional context. The general goal of this subject is to acquire knowledge on metabolic regulation and interrelationships among tissues in mammals, and more devoted, in humans.

Its main goal is the understanding of the human pathology and of the diagnosis of diseases through clinical laboratory testing in the current and future settings of molecular medicine. With this objective, the different topics of the course will emphasize the following points: (1) Mechanisms that determine the metabolic phenotype of each tissue, (2) Regulation of metabolism based on the control of gene expression, (3) The importance of genetic and epigenetic regulation, (4) Short- and long-term regulation of metabolism, (5) Tissue differences and metabolic flow between tissues, and (6) How these processes are regulated and coordinated in various physiological and pathological conditions. The knowledge, skills, and scientific language acquired will provide the essential groundwork for comprehensively understanding the most practical and advanced clinical teachings.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

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Acknowledge diversity and multiculturality.

Be able to formulate hypothesis, gather information and evaluate it critically in order to solve problems by following the scientific method.

Capacity for communicating with professional circles from other domains.

Consideration of ethics as a fundamental value in the professional practise.

Criticism and self-criticism skills.

Establish a good interpersonal communication which may allow professionals show empathy and talk to the patients efficiently,as well as to their relatives, the media and other professionals.

In the professional practise, take a point of view which is critical, creative, constructive and research-oriented.

Know how to use IT in clinical, therapeutic and preventive activities, and those of research.

Know how to use the sources of clinical and biomedical information available, and value them critically in order to obtain, organise, interpret and communicate scientific and sanitary information.

Knows the cell structure and its function. Implication of biomolecules. Knows the metabolism, its regulation and metabolic integration.

Knows the mechanisms of information, expression and genetic regulation. Inheritance patterns.

Knows the procedures in cell communication and the function of excitable cell membranes.

Knows the processes of growth, maturation and aging of the different organs and systems. Homeostasis. Adaptation to the environment.

Proper organisation and planning of the workload and timing in professional activities.

Team-working skills and engaging with other people in the same line of work or different.

Understand and recognise the effects of growth, development and aging which affect individuals and their social environment.

Working capacity to function in an international context.

DESCRIPTION OF CONTENTS

1. THEORETICAL LESSONS (Part I)

I. THE REGULATION OF METABOLISM
1. Metabolic regulation: Tissue-specific mechanisms and short- and long-term adaptations.

II. THE REGULATION OF GENE EXPRESSION
2. Transcriptional regulation: prokaryotic and eukaryotic.
3. Molecular bases of tissue phenotype: tissue-specific transcription factors and epigenetics.
4. Regulation of transcription by nuclear receptors in response to hormones, vitamins and metabolic signals.
5. Post-transcriptional regulation of mRNA levels.
6. Regulation of protein synthesis and degradation.

III. METABOLIC FLOW BETWEEN TISSUES AND ADAPTATION OF METABOLISM
7. Metabolic integration: adaptation to fasting.
8. Intertissue flow of nutrients (I): carbohydrates.
9. Intertissue flow of nutrients (II): triacylglycerides, free fatty acids and ketone bodies.
10. Intertissue flow of nutrients (III): amino acids.
11. Oxygen metabolism and its reactive species: biochemical and molecular bases of oxidative stress.

2. THEORETICAL LESSONS (Part II)

IV. METABOLIC INTEGRATION IN TISSUES, ORGANS AND SYSTEMS
12. Metabolic integration in the kidney.
13. Metabolic integration in the erythrocyte.
14. Biochemistry of the blood and vascular system.

15. Metabolic integration in the brain.
16. Metabolic integration in adipose tissue.
17. Skeletal muscle: metabolic aspects.
18. Heart muscle: biochemical aspects.
19. Biochemistry of the extracellular matrix.
20. Hepatic biochemistry (I): glycemia, nitrogen metabolism and plasma proteins.
21. Hepatic biochemistry (II): lipid metabolism and fatty liver.
22. Hepatic biochemistry (III): metabolism of bile acids, cholesterol, bilirubin, iron and copper.
23. Hepatic biochemistry (IV): xenobiotic metabolism and hepatotoxicity.

V. THE BIOCHEMISTRY OF THE DISEASE
24. Biochemistry of inflammation.
25. Biochemistry of fibrosis of organs and tissues.
26. Molecular biology of cancer I: the microevolutionary advantages of the tumor cell.
27. Molecular Biology of cancer II: altered genes and pathways in cancer.
28. Biochemistry of peripheral insulin resistance.
29. Biochemistry of protein misfolding.
30. Biochemistry of aging.

3. PRACTICES

SEMINARS

1. Introduction to the Clinical Biochemistry Laboratory: Sample collection and storage. Handling and biological hazards. Analytical techniques. Quality control.
2. Introduction to Clinical Enzymology: Biomarkers and clinical cases.
3. Study of serum electrophoretic patterns: Clinical cases.
4. Polymerase chain reaction and its application in research and clinical diagnosis.
5. The molecular biology in the clinical diagnosis.

LABORATORY PRACTICES

1. Clinical enzymology: Measurement of serum enzyme activities.
2. Study of the isoenzymatic profile of LDH in different pathologies.
3. Study of serum lipids.
4. Study of nitrogen metabolism.
5. Metabolic adaptation to fasting: quantification of ketone bodies.
6. Gene expression analysis using PCR.

REGLATED TUTORIALS

Experimental models in biomedicine: From the laboratory bench to the clinic.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	4,00
Theory	33,00
Seminar	11,00
Laboratory	12,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	27,50
Independent study and work	45,00
Preparation of lessons	10,00
Preparation for assessment activities	7,50
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

Face-to-face training activities for this subject will include lectures, practical classes, seminars, supervised tutorials, and exams.

During the **theoretical lectures**, the professor will present the content and methodology for the knowledge and skills that students need to acquire. The theoretical sessions will be conducted through interactive lectures.

In the **practical sessions**, students will conduct laboratory practices, where they will analyze the principles and application of both common and advanced techniques in Biomedicine, as well as problem- solving according to the specific objectives and content of each session. In these classes, students will work in small groups following a protocol provided by the professor. The sessions will be initiated with a brief theoretical-practical explanation, but the objective is to boost the autonomous and in group work of the student, in such a way that at the end of the practice the student will show concrete results that will be contrasted by the professor.

These practical sessions are reinforced with the Seminars in which the professor will use the master class approach but boosting the student's participation with questions. Lastly, personal and in-group tutorials will be held, as well as the elaboration and exposition of guided topics (tutored works) that will deal with issues in the field of biomedical research.

The gender perspective, the respect for diversity, and the sustainable development goals (SDGs) will be incorporated into teaching, whenever possible.

EVALUATION

The assessment of learning in theoretical teaching, seminars, and practical classes is conducted through a final written exam, which accounts for 90% of the overall grade of the course, complemented by the grade obtained in supervised tutorials (tutoring group), a voluntary practical teaching activity that represents 10% of the overall grade of the course.

The final written exam consists of two parts:

The first part includes 6 essay questions based on the theoretical program content, aiming to evaluate the acquisition of knowledge and the student's level of exposition. Each question is worth a maximum of 0.5 points, totaling a maximum of 3 points (30% of the overall grade).

The second part comprises 60 multiple choice questions, each with 4 possible answers of which only one is correct. These questions assess both the acquisition of competencies from theoretical teaching and from seminars and practical classes. Each correct answer is worth 0.1 point, each incorrect answer deducts 0.025 points, and unanswered questions do not affect the score. Approximately one half of the questions evaluate theoretical teaching and the other half seminars and practical classes.

To pass the course, the student must achieve a minimum of 1 point in the first part and 2 points in the second part of the exam.

Supervised tutorials (tutoring groups) will have ongoing assessment based on attendance, participation, and the student's ability to react to complex specific situations. The maximum grade for tutorials will be 1 point, contributing 10% to the overall grade of the course.

Overall, theoretical teaching accounts for 60% of the overall course grade, while the remaining 40% depends on the learning from practical teaching (seminars, laboratory practices, and supervised tutorials).

Attendance at practical activities is mandatory. The student is considered to meet this requirement if he or she has attended a minimum of 80% of these activities and has adequately justified the impossibility of attending the remaining sessions due to the occurrence of a cause of force majeure. It will be essential to comply with this requirement to pass the subject.

Students are reminded of the importance of carrying out evaluation surveys on all the teaching staff of the degree subjects.

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