COURSE DATA

DATA SUBJECT

Code: 36860
Name: Microscopic Techniques
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1106 - Degree in Biology	Facultat de Ciències Biològiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1106 - Degree in Biology	Optatividad	ELECTIVES

COORDINATION

CRESPO RUPEREZ CARLOS

VAREA LOPEZ EMILIO

SUMMARY

Microscopic Techniques is an optional subject offered in the fourth year of the Biology degree. Its aim is for students to learn the main optical and electron microscopy techniques used to study animal and plant cells and tissues. The subject has a methodological approach and a predominantly practical character. On the one hand, it analyzes the microscope as a working tool, emphasizing the advantages offered by each of the different types. On the other hand, it covers all the histological processing and cell labeling techniques necessary for preparing samples for optical and electron microscopy. It also analyzes the different methodological strategies that allow for establishing a correlation between both types of microscopy.

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PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

No prior requirements or recommendations. There are no enrollment restrictions with other subjects in the curriculum.

COMPETENCES / LEARNING OUTCOMES

1106 - Degree in Biology

(CB3) Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

(CB4) Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

(CB5) Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Design and conduct experiments by using scientific techniques and instruments appropriately and complying with laboratory safety regulations.

Knowing how to integrate knowledge between the structure and function of cells, tissues and animal and plant organs.

Knowing how to integrate the biological processes of obtaining energy and the mechanisms of cell signaling.

Knowing how to obtain, process and analyze material of biological origin applying histological techniques for optical and electron microscopy.

Organise, plan and manage information in a manner that allows the individual to analyse, synthesise and develop critical reasoning that can be applied to solve problems, make decisions and carry out work.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

DESCRIPTION OF CONTENTS

Unit 1. Conventional optical microscopy.

Image formation theory. Elements of the bright-field optical microscope. Numerical aperture of lenses and resolution. Optical aberrations and correction.

Unit 2. Unconventional optical microscopy.

Dark-field microscopy. Phase-contrast microscopy. Differential interference microscopy. Polarized light microscopy.

Unit 3. Fluorescence microscopy.

Conventional fluorescence microscopy. Confocal microscopy. Multiphoton microscopy.

Unit 4. Electron microscopy.

The transmission electron microscope. The scanning electron microscope. Spectroscopy in scanning electron microscopy.

Unit 5. Sample preparation for optical and electron microscopy.

Introduction to histological technique. Types of samples for light microscopy. Types of samples for transmission electron microscopy: ultrathin sections; cryofracture; negative staining. Sample preparation for scanning electron microscopy.

Unit 6. Fixation.

Physical and chemical fixation. Fixation by immersion and perfusion. Fixative agents and mechanisms of action on tissue. Fixative mixtures for optical and electron microscopy.

Unit 7. Embedding and sectioning.

Embedding methods and techniques for optical and transmission electron microscopy. Paraffin, sliding, and freezing microtomy. Vibratome. Ultramicrotomy. Handling and mounting ultrathin sections on grids.

Unit 8. Staining techniques.

Types of dyes. Chromophore, chromogen, and auxochrome groups. Mordants. Orthochromasia, metachromasia, and allochromasia. Routine staining.

Unit 9. Histochemical Techniques.

Histochemical detection of carbohydrates, lipids, nucleic acids, and metals. Histoenzymology. Lectin labeling.

Unit 10. Immunocytochemical Techniques.

Polyclonal and monoclonal antibodies. Direct and indirect methods. Detection systems for light and electron microscopy.

Unit 11. Cell Activity Labelling Techniques.

Pulse-capture experiments. Autoradiographic techniques. Cell proliferation detection techniques. Cell death detection techniques.

Unit 12. Cell cultures.

Cell cultures. Explants and organotypic cultures. Cell lines.

Laboratory Practices.

Practice 1. Fixation, Embedding, and Sectioning.

Practice 2. Sample Preparation and General Staining.

Practice 3. Cell Labelling Techniques: Histochemical and Immunocytochemical Techniques in Histological Sections.

Practice 4. Sample Preparation for Electron Microscopy.

Practice 5. Image Analysis Techniques.

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WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	25,00
Laboratory	20,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	20,00
Preparation of lessons	23,00
Preparation for assessment activities	24,50
Resolution of case studies	0,00
Total hours	**67,50**

TEACHING METHODOLOGY

The acquisition of the necessary knowledge by the student will be based on three fundamental pillars:

1. Theory Classes.

Theory classes consist of one-hour face-to-face sessions where the professor orally transmits the subject matter to the student. This transmission is supported at all times by the teaching materials that the professor deems appropriate for each topic. In the theory classes, the professor will encourage student participation by asking questions or posing topics and issues that stimulate debate. The Virtual Classroom will be used as a tool where the professor can provide the student with all the teaching materials he considers appropriate to complement the theory classes.

2. Practical Laboratory Classes.

The practical classes consist of four-hour laboratory sessions where the student works and learns the methodology necessary for the manipulation and microscopic analysis of cells. All practical classes are closely related to the content of the topics covered in the theory classes. Overall, the laboratory work is aimed at teaching the student how to obtain and manipulate cell and tissue samples, process them, label them and stain them for observation using different types of optical microscopes and the transmission electron microscope.

3. Independent Student Work.

This should be considered as all the work the student dedicates to preparing for the course outside of attending lectures and participating in laboratory sessions. It includes various activities. On the one hand,

there are the study hours that should be dedicated each week to expanding and reinforcing the knowledge acquired in lectures and laboratory sessions. It also includes any additional work that the professor may assign for the student to complete throughout the semester as a complement to lectures and laboratory sessions.

Summary of teaching methodologies:

- Lectures and practical classes.

- Case analysis and studies.

EVALUATION

To assess the theoretical and practical knowledge acquired, an exam will be administered, consisting of two different tests: one with questions on the theory portion and another with questions on the practical portion of the course. Students must achieve a minimum score of 5 out of 10 on each test to pass the course. The score obtained on the theory test will account for 80% of the final grade. The score obtained on the practical test will account for the remaining 20% of the final grade.

REFERENCES

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