COURSE DATA

DATA SUBJECT

Code: 36842
Name: Microbiology
Cycle: Undergraduate Studies
ECTS Credits: 10.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1106 - Degree in Biology	Facultat de Ciències Biològiques	3	Annual

SUBJECT-MATTER

Degree	Subject-matter	Character
1106 - Degree in Biology	Microbiología	COMPULSORY

COORDINATION

PUJALTE DOMARCO M JESUS

PINA PEREZ MARIA CONSUELO

MAICAS PRIETO SERGI

SUMMARY

This course, a compulsory third-year course, provides a basic introduction to the biology of microorganisms, including prokaryotes, eukaryotes, and viruses. The program covers metabolic, structural and functional, genetic, and growth aspects before moving on to the specific systematics of each group. The program briefly addresses some aspects of microbial ecology, especially the interactions of microorganisms with other living organisms, and is completed with some introductory topics on the applied aspects of microbiology. The fundamental objective of the Microbiology practical program is to familiarize the student with the specific methodology of working with microorganisms, particularly the techniques for isolation, cultivation, and quantification of microbial populations. It is a priority aim that students learn how to work with microorganisms under aseptic conditions and basic safety regulations. Another part of the practical program is aimed at illustrating aspects of the theoretical module program, especially structure and function, metabolism, growth and environment, viruses, and identification.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

The course requires knowledge of eukaryotic cell cytology, the basics of Genetics, Molecular Biology, Metabolism and Regulation, as well as having completed the first-year courses Cell Biology and Tree of Life.

COMPETENCES / LEARNING OUTCOMES

1106 - Degree in Biology

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

Correctly apply the specific terminology of microbiology and understand the theories, history and trends of this science, being able to relate all these to other scientific disciplines; integrate knowledge of the biology of the main groups of microorganisms in terms of structural, metabolic, genetic, ecological, taxonomic, evolutionary and applied characteristics; use basic microbiological laboratory techniques and use and analyse documentary sources in the field of microbiology.

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

Develop the skills needed to carry out a professional activity with a proactive attitude towards the world of work and with an innovative and entrepreneurial spirit. Be able to apply sustainability criteria and to work within the framework of professional ethics.

Interpret, analyse, evaluate, process and synthesise biological data and information by applying mathematical and statistical methods.

Interpret the functioning of the mechanisms of biological inheritance and the applications in recombinant DNA technology and genetic engineering.

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.

Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía

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 be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

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.

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

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.

That students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the development and defense of arguments and the resolution of problems within their area of ¿¿study

To correctly apply the specific terminology of Microbiology and understand the theories, history and trends of this science, being able to relate them to other scientific disciplines; to integrate the knowledge of the biology of the main groups of microorganisms in their structural, metabolic, genetic, ecological, taxonomic, evolutionary and applied aspects; to be proficient in basic microbiological laboratory techniques, and to handle and analyze documentary sources of Microbiology.

Understand and relate the structure and function of biomolecules and interpret the functioning of the mechanisms of replication, transcription, translation and mutation. Be familiar with the techniques, methodologies and basic instruments of the molecular biology laboratory.

Use ICTs, apps and other computer tools to manage and disseminate information in both educational and professional environments.

Use scientific language, both oral and written, and be able to adapt the register to the target audience and/or readers. Use the most common foreign languages in each discipline as a vehicle for communication in a globalised system.

DESCRIPTION OF CONTENTS

THEORY

INTRODUCTION TO MICROBIOLOGY

Concept of Microbiology. Historical Development.

Nature of the microbial world: primary divisions among microorganisms: historical approach. Basic differences among microorganisms: viruses, bacteria and archaea, fungi, and protists.

PROKARYOTIC CELL STRUCTURE AND FUNCTION

Prokaryotic cell: shape and size. Cytoplasmic membrane: structure and composition in archaea and bacteria.Functions associated with the prokaryotic membrane. Invaginations and compartments. Cytoplasm.

Cell wall of bacteria and archaea. Structural and chemical differences between bacteria. Murein or peptidoglycan: structure, composition, and biosynthesis. Cell wall growth and agents that affect it. Gram-negative cell wall. Gram-positive cell wall. Functional differences between both groups. Mycobacterial cell wall.

Structures related to motility. Bacterial flagella: structure and mechanism of motility. Archaeal flagella. Tactism: molecular basis. Magnetosomes. Gas vacuoles. Motility in spirochetes. Gliding motility.

Adherence structures: Capsules, fimbriae, biofilms. Storage materials and other cytoplasmic inclusions. - Structural and/or functional differentiation in prokaryotes. Unicellular bacteria: cell growth and division: processes involved.Filamentous and mycelial bacteria. Alternative cellular types: bacterial endospores. Other representative life cycles

NUTRITION AND METABOLISM

Principles of microbial nutrition and cultivation. Nutritional categories. Media design and culture conditions. Microbial metabolism: Energy flows, reducing power, and precursor metabolites.

Fueling reactions in aerobic and anaerobic heterotrophs. Anaerobic respiration and fermentation.

Fueling reactions in autotrophs. Generation of precursor metabolites: diversity of autotrophic pathways. ATP generation and reducing power in chemolithotrophs and photoautotrophs: oxygenic and anoxygenic photosynthesis.

GROWTH AND ENVIRONMENTAL FACTORS

Microbial growth: basic parameters. Growth curve of a population in a closed environment: phases. Growth as a function of nutrient concentration, yield, and maintenance energy. Continuous culture: definition and main parameters. Chemostats.

Influence of physicochemical factors on microbial growth and viability. Temperature. Water activity. pH. Oxygen. Hydrostatic pressure. Radiation. Extreme environments.

Control methods: disinfection, antisepsis, and sterilization. Physical and chemical methods.

GENETICS AND VIROLOGY

Genetic differences between prokaryotes and eukaryotes: genomic organization, replication, transcription, translation, and regulation of gene expression. Horizontal transfer of genetic information in prokaryotes: transformation, conjugation, and transduction.

Viruses: structure and types. Virus detection and enumeration. Kinetics of viral multiplication. Bacteriophages: general characteristics and main groups. Lytic and lysogenic cycles.

Eukaryotic viruses: Animal and plant viruses. Consequences of viral infection in animal cells. General characteristics of the main groups. Viruses of eukaryotic microorganisms. Subviral agents.

MICROBIAL DIVERSITY

The classification of microorganisms: intrinsic problems. Phenetic and phylogenetic classification. Definitions and methodologies. Nomenclature. Identification.

Prokaryotic diversity: Archaea: General characteristics and main phyla.

Bacteria: General characteristics and main phyla.

Eukaryotic microorganisms. Fungi: main groups. Protists: main groups.

MICROBIAL INTERACTIONS

Microorganisms and their environment: microbial habitats. Microorganisms in food chains and the biogeochemical cycles of C, N, and S. Relationships between microorganisms and other living beings: symbiosis. Examples of mutualistic ecto- and endosymbiosis. Human microbiota.

Host-parasite relationships. Pathogenesis and virulence: virulence factors. Adhesion, colonization, invasiveness. Toxins. Microbial interaction with host defenses. Nonspecific and specific defenses.

Antimicrobial agents: disinfectants, antiseptics, antibiotics, and synthetic antimicrobials. Antimicrobial resistance. Vaccines.

APPLIED MICROBIOLOGY

Biotechnological applications of microorganisms: food production and preservation, industrial production, agriculture and livestock, and environmental waste management.

LABORATORY PRACTICES

Microbiology laboratory work standards. Sterilization methods.

Handling microorganisms under aseptic conditions. Inoculation techniques.

Obtaining pure microbial cultures. Characteristics of colonial growth.

Microbial nutrition and culture: types of culture media according to their nutritional and physicochemical characteristics.

Bacterial and fungal culture. Selective and differential media. Enrichment cultures.

Visualization of microorganisms with optical microscopy. Simple and differential stains (Gram, spores).

Total and viable microorganism counts: microscopic chamber count, spread plate count, membrane filtration counts.

Bacteriophage culture and enumeration.

Antimicrobial sensitivity: antibiogram.

Detection of microbial activities: extracellular enzymes, oxidative and fermentative activity on carbohydrates, fermentative pathways, catalase and oxidase. Gram KOH.

Identification of microorganisms using miniaturized methods and numerical profiling. Identification by comparative analysis of gene sequences.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	2,00
Theory	71,00
Laboratory	32,00
Total hours	**105,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	86,00

Preparation of lessons	51,50
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**157,50**

TEACHING METHODOLOGY

The course is structured as follows:

- **Sixty-six one-hour theory sessions**, to cover the topics in the theoretical program. These sessions must be preceded by students reading the chapters or sections indicated in the Study Guides and the core text. These sessions run from the beginning of the course until the end of the theoretical content. They may include theoretical sessions on practical content, also the exhibition of some works done by the students. Attendance at these sessions is optional.

- **Sixteen two-hour laboratory practice sessions**, for the completion of the practical program, after reading the practical booklet provided by the instructor in advance. **Attendance at practical sessions is mandatory**. Absences, up to a maximum of two, must be adequately justified. Since the acquired skills are continuously assessed throughout the practical sessions, failure to attend three or more practical sessions will require the student to take an additional practical exam in the laboratory, which must be passed to pass the course

- Two **group tutorials** focused on the discussion and completion of model questionnaires, discussion of current topics in Microbiology (prior distribution of the material) or books for dissemination and/or discussion of doubts.

The number and quantity of personal tutorials that each student wishes to request, subject to prior agreement with the teacher: it is recommended that each student undertake a minimum of four personal tutorials throughout the course, including the revision of their exams, regardless of the result.

- **Complementary activities**: students, either individually or in pairs, will carry out evaluable tasks related to the subject by agreement with the responsible teaching staff, such as comments on scientific articles, critical analysis of contents related to Microbiology in the media, participation in outreach activities and programs and any others that are **previously agreed upon with the teaching staff**.

EVALUATION

Students must obtain a minimum of 50 points out of 100, with the following distribution:

THEORY: 70 points out of 100. The minimum required to pass the theory exam is 35 points,

obtained in two possible ways:

a) Through two midterm exams. At the end of the first semester, a midterm exam will be held that will allow students to eliminate the material taught during that semester (approximately 50% of the total). Students who pass this first midterm exam will only have to take the remaining material through a second midterm exam, which will coincide with the date of the first sitting. If they do not pass this second midterm exam, students must take a final exam on all the material taught in the theory classes in the second sitting.

b) Through a final exam. In the first or second sitting, provided that the theory exam has not been passed through midterm exams as indicated in the previous section.

- Class attendance: optional

- The theory exam must be passed independently of the practical exam.

PRACTICAL WORK: 20 points out of 100.

Mandatory attendance (minimum 14/16 sessions).

- Practical exam: up to 18 points. Up to 2 points will be awarded by the faculty for continuous assessment during the sessions. Minimum required: 10 points. There will be a test shortly after the end of the last session and another (for those who did not pass) in the second session.

- Failure to attend three or more practical sessions will require the student to take an additional practical exam in the laboratory, which must be passed to pass the course.

- The practical assessment must be passed independently of the theory assessment.

- Second-year students (repeating students) who completed the minimum required number of practical sessions in the immediately preceding course may, if they so choose, not attend in-person laboratory classes and may retain the grade for the practical exam they passed, provided this is certified by the professor responsible for the previous course. This accreditation must be submitted during the month of October of the current academic year.

COMPLEMENTARY ACTIVITIES: 10 points out of 100

Their assessment will be added to the grade obtained after passing the theory and practical classes independently, up to a maximum of 10 points. These 10 points will correspond to the sum of the points obtained for activities linked to group tutoring (up to 5 points) and those completed independently of the group tutoring sessions (5 points), according to the tabulated distribution of

the evaluation systems.

Evaluation systems	Weighing
1. Written, oral or practical exams	Up to 88 points (70 + 18)
2. Evaluation of seminars and group tutorials	Up to 5 points
3. Continuous evaluation of laboratory practices	Up to 2 points
4. Evaluation of papers, reports and/or oral presentations	Up to 5 points

REFERENCES

Basic

- Prescott¿s Microbiology. Willey, J.M., Sandman, K. & Wood, D. 2023. 12th ed. Mc Graw Hill (International Edition)

- Brock- Biology of Microorganisms Madigan, M.T., Bender, K.S., Buckley, D.H., Sattley W.M. & Stahl, D.A. 2022. 16th ed. Pearson (Global Edition)

- Microbiología Esencial. Martín, A., Béjar, V., Gutiérrez, J. C., Llagostera, M. y Quesada, E. 2019. 1ª ed. Editorial Médica Panamericana

Complementary

- Microbe. Schaechter, M., J. L. Ingraham & F. C. Neidhard. 2006. 1st ed. ASM Press. Washington DC.

- Microbiology, An Evolving Science. Slonczewski, J.L., Foster, J.W., Zinser, E.R. 2023. 6th ed. W. W. Norton & Company

- The Prokaryotes. Rosenberg, E., DeLong, E. F., Lory, S., Stackebrandt, E. & Thompson F. 2014. 4th ed. Springer