

**COURSE DATA****DATA SUBJECT**

Code: 43021
Name: Fundamentals of research in microbiology
Cycle: Master's Degree
ECTS Credits: 15
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2137 - Master's Degree in Biomedical Research	Facultat de Medicina i Odontologia	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2137 - Master's Degree in Biomedical Research	Fundamentals of clinical research in biomedicine	ELECTIVES

COORDINATION

RODRIGUEZ DIAZ JESUS

SUMMARY

In this module, the lines of research in Clinical Bacteriology, Clinical Virology and Clinical Mycology and Parasitology are analysed. Besides, the main syndromes of infectious diseases, analyzing its ethiopathogenesis, microbiological diagnostic and therapeutic approaches will be studied, with a special focus on recent advances in research in each of the sections covered in the program.

The main objective of the module is to provide the student with basic training in the field of biomedical research related to Clinical Microbiology, including clinical bacteriology, virology, mycology and parasitology. Through the scientific method and the systematic process of an increasingly multidisciplinary research, the achievement of these general objectives is proposed:

- To acquire a solid basis in the methodology of biomedical research applied to the world of Clinical Microbiology, acquiring the necessary training to carry out research on these issues both in the laboratory and in the clinic.



- To create a new climate that favours research in the field of Clinical Microbiology, integrating the student in the research activity of the different Departments of the Faculty of Medicine and the University Hospitals attached to them.

- To encourage the researcher by establishing a flexible and dynamic system to adapt to the development phase of a consolidated group or in emerging groups in a differentiated way, as well as to the acquisition of the necessary bases for its understanding, mentioning and studying in a more specific way each of the sections dealt with in the program.

A second part of this module, starting in March, will be held at the Principe Felipe Research Center (CIPF). The overall aim will be the theoretical-practical development of content related to the methodologies currently used in biomedical research in different areas: genetics, biomarkers, neuroscience, bioinformatics, nanomedicine, cell therapy, etc.

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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Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

To have the ability to apply the foundations of the scientific methodology to the clinic investigation in human beings.



To have the ability to design, perform and analyse clinical protocols and essays.

To have the ability to integrate and to teamwork within a group of consolidated biomedical research.

To know how to make a suitable bibliographical and documentary search in order to know the state of the art of the issue.

DESCRIPTION OF CONTENTS

1.

Type of host-parasite relationship. Colonization, infection and infectious disease. Determinants of pathogenicity and virulence factors of interest in infection. Stages of the infectious process. Update on etiopathogenic aspects of infections in humans.

2. The human microbiome in 3P medicine (predictive, preventive, and personalized).

The Human Microbiome: User's Manual. Human microbiome in health and disease: alterations in different pathophysiological states. The panmicrobiology of the human microbiome.

3. Biological risk.

Introduction to biological risk. Basic concepts and classification of biological agents. Current regulations. Microorganisms and safety level.

4.

Direct diagnostic procedures: conventional methods vs. molecular diagnosis. Molecular diagnostic methods and their indications. Rapid antigenic detection techniques and their indications. Indirect diagnostic procedures: Serological methods and their indications. Detection of cellular immune response.

5. Infections associated with biomedical devices and foreign bodies.

Infections associated with joint prostheses. Sampling. Culture of joint fluid. Periprosthetic biopsy culture. Microorganisms responsible for infections associated with joint prostheses. Microbiological diagnosis, study of antibiotic sensitivity and modification of the therapeutic regimen.



6. Microbiology and nosocomial infection.

Concepts, etiopathogenesis and epidemiological aspects. Clinical syndromes in nosocomial infection and microbiological diagnostic approaches. Microbiological study and advances in molecular characterization of nosocomial outbreaks by the following microorganisms: *Acinetobacter baumannii*, *Staphylococcus aureus*, BLEE-producing Enterobacteriaceae, *Pseudomonas aeruginosa*, yeast-like fungi (*Candida* spp.) or filamentous fungi (*Aspergillus* spp.)

7. Forensic Microbiology.

Concept of forensic microbiology. Applications of forensic microbiology. Clinical or anatomopathological autopsy. Post mortem autopsies. Judicial or medico-legal autopsy. Microbiological techniques: serology, specific PCR, bacterial culture, viral culture. Guidelines and consensus. Bioterrorism. Environmental research. The human post mortem microbiome. The human virome.

8. Antibiotics Classification according to targets.

Update on antibacterials. Classification according to their targets and mechanisms and new molecules against the increase in multi-resistance.

9. Resistance mechanisms of microorganisms to antibacterial agents.

Methods and current lines of research on resistance in gram-positive and gram-negative. New resistance detection methods. Interpreted antibiogram. Characterization of resistotypes in bacteriology and its clinical interest.

10. Advances in the microbiological diagnosis of viral infections.

Direct virological diagnostic procedures: Molecular diagnostic methods in clinical virology and their indications. Rapid antigenic detection techniques in clinical virology and their indications. Indirect diagnostic procedures for viral infections: Serological methods. Main indications and current lines of research.

11. Clinical Virology Research.

Structure, multiplication and classification of viruses of medical interest. General diagnostic approaches and current lines of work in infections by viruses of clinical interest: HSV, CMV, VEB, Erytrovirus, Papillomavirus, Respiratory viruses, Hepatitis viruses, Neurotropic viruses, HIV. Update on emerging and re-emerging viruses: Coronavirus (SARS-CoV, MERS and SARS CoV-2), Ebola virus, Nipah virus and Hendra virus. Hemorrhagic fever viruses. Defective Prions and Viruses.



12. Methods of analysis of the antiviral immune response

Special Study of Acute Viral Infections: Gastrointestinal Infection Model. Molecular virology of gastrointestinal infections by Rotavirus, Astrovirus and Calicivirus. Special study of chronic-persistent viral infections: Herpesviridae, Retroviridae, Hepaciviridae models. Transforming Viral Infections.

13. New Antivirals and Their Clinical Indications.

Search and development of antivirals. Clinical applications. Special Study of Antiretrovirals and Antivirals Active Against Hepatitis C Virus, Hepatitis B Virus, and SARS-CoV-2.

14. Research in clinical mycology.

Current situation of fungal infections and emerging processes. Specific diagnostic methods in mycology. Diagnostic approaches and advances in fungal infections that produce superficial, subcutaneous and systemic mycoses. Study of infections caused by fungal infections that produce opportunistic mycoses: zygomycosis, pheohyphomycosis, hyalohyphomycosis and aspergillosis. Antifungals and resistance of yeast and filamentous fungi. Current lines of research.

15. Research in clinical parasitology.

Classification, anatomofunctional and pathogenic characteristics of protozoa and helminths associated with infections in humans. Update on intestinal, genitourinary, tissue and hematic protozoa. Classification and study of the different helminthiases associated with infectious pathology. Classification and updating in antiparasitic treatment. Resistance mechanisms. Current lines of research.

16. CIPF. Diagnosis and treatment of rare diseases

Discovery of new genes associated with Mendelian diseases. Genealogy Workshop. Models and therapies for the study of hereditary retinal dystrophies.

17. CIPF. Bioinformatics

Introduction to transcriptomics and high-throughput technologies. Exploration and pre-processing of gene expression data. Differential expression analysis. Functional enrichment.

18. Biostatistics.

Introduction to free software R and Rstudio. Univariate and multivariate descriptive statistics. Basic concepts of statistical inference. Parametric and non-parametric hypothesis tests. Analysis of variance. Regression models: linear and generalized linear.



19. CIPF. Cancer biology

Introduction to cancer: What is cancer. cancer properties. Cancer genetics: Oncogenes and tumor suppressors. Growth factors, receptors and cancer. Oncogenic signaling. Tumor stem cells or cancer stem cells (CSC). Cancer and placentation. Tumor and Stroma.

20. CIPF.Neuropsychiatric pathologies: hepatic encephalopathy and schizophrenia

Hepatic encephalopathy. animal models. Neuroinflammation and alterations in neurotransmission. therapeutic implications. Ex vivo and in vivo study. behavioral studies. Analysis of neurotransmission by cerebral microdialysis in vivo. Molecular psychiatry: pathophysiology of cortical circuits. The cortex, the most complex region of the brain. Pathologies of the neurological development of cortical circuits. What happens if something goes wrong? The golden age of neurobiology: new tools to investigate cortical circuits.

21. CIPF. Cellular therapy

Pluripotent stem cells: fundamentals and types. iPS cells as a tool to study diseases. Cell Therapy in pathologies of the nervous system.

22. CIPF. Drugs and biomarkers

Nanomedicine in research and medical practice. Cell models for biomedical research. Animal experimentation models in drug development. Intercellular communication by exosomes and their use as biomarkers. Gut microbiota as functional food and biomarker of metabolic disease.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	45,00
Other activities	0,00
Laboratory	21,00
Total hours	66,00

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	45,00
Individual or group project	100,00
Independent study and work	130,00
Preparation of lessons	0,00
Preparation for assessment activities	25,00



Resolution of case studies	0,00
Total hours	300,00

TEACHING METHODOLOGY

Teaching methodology, material and work structuring for the module in clinical microbiology:- Approaches of the di
- Discussion in seminars of the work developed by the student individually or in groups.- Online teaching methods: b

- Presentation of the module, objectives, general and specific contents, structure, operation and possibilities of work to be carried out by each student.
- Approaches of the different projects based on the contents of the program and/or lines of work.
- Review sessions on the technical and scientific problems proposed by each student in the development of their work and their resolution.
- Presentation of the results obtained by each student from the proposed teaching-research projects and discussion on this topic.
- Conclusions obtained and problems proposed throughout the completion of the course by students and teachers and evaluation of the knowledge acquired.

tion of the knowledge acquired.

EVALUATION

MICROBIOLOGY SESSIONS (50% GLOBAL MARK):

The evaluation will be both continuous evaluation, assessing attendance and participation, as well as the work presented and the final exam, applying the following sections:

1. Continuous evaluation of the active participation in the face-to-face sessions and seminars (25%) where the professor responsible for the session will evaluate the degree of involvement, interest and preparation based on the material previously supplied through the Virtual Classroom of the UV, as well as the content of the final work assigned to each student,
2. Exhibition and defense (25%) in class of the final work assigned to each student in the first session, assessing its scientific content and the ability to transmit the knowledge acquired.
3. Exam (50%) with multiple-choice questions (30 tests) with a valid answer, which will include those contents worked on in the scheduled face-to-face sessions, seminars and papers presented by each of the students.

CIPF SESSIONS (50% GLOBAL MARK):

1. Resolution of two questions chosen from a battery of practical questions.

REFERENCES



- -La bibliografía específica se facilita por el profesor directamente a los alumnos que van a realizar el módulo y el trabajo correspondiente. Esto cambia cada año. -Los alumnos disponen en el Aula virtual las referencias necesarias para el desarrollo del curso.
- -Murray PR, Rosenthal KS y Pfaller MA. (2021). Microbiología médica 9ª ed. Elsevier España SL. ISBN: 9788491138082 - Prats Pastor, G. (2013). Microbiología y parasitología médicas. Editorial Médica Panamericana SA. Madrid. ISBN: 9788491106111 - Ryan KJ, Ray CG. (2017). Sherris Microbiología Médica. 6ª ed. Editorial McGraw Hill. ISBN 9786071514127 - Bennett JE, Dolin R y Blaser MJ. (2020) Mandell, Douglas y Bennett. Enfermedades Infecciosas. Principios y Práctica 9ª ed. Elsevier España SL. Vol I. ISBN: 9780443065811 - García Sánchez JE, López R y Prieto J eds. (1999). Sociedad Española de Quimioterapia. Antimicrobianos en Medicina. Prous Science. ISBN 84-8124-167-9 - Carroll KC et al. Manual of Clinical Microbiology (2019). 12th Edition. ASM Press. Washington DC. ISBN 978-1-555-81983-5