



Universitat de Lleida

DEGREE CURRICULUM  
**MICROBIOLOGICAL BASIS OF  
INFECTION**

Coordination: BELLI MARTINEZ, GEMMA

Academic year 2022-23

## Subject's general information

<b>Subject name</b>	MICROBIOLOGICAL BASIS OF INFECTION			
<b>Code</b>	100531			
<b>Semester</b>	2D SEMESTER - DEGREE - JUN/SET			
<b>Typology</b>	Degree	Course	Character	Modality
	Bachelor's Degree in Medicine	2	COMPULSORY	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRALAB	PRAULA	TEORIA
	<b>Number of credits</b>	2	0.8	3.2
	<b>Number of groups</b>	10	2	1
<b>Coordination</b>	BELLI MARTINEZ, GEMMA			
<b>Department</b>	BASIC MEDICAL SCIENCES			
<b>Teaching load distribution between lectures and independent student work</b>	Attended hours: 60 Non attended hours: 90			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	Catalan and Spanish			
<b>Distribution of credits</b>	Magistral: 32 Practices: 20 Seminars: 8			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
BELLI MARTINEZ, GEMMA	gemma.belli@udl.cat	13,7	
CASTELLS ROCA, LAIA	laia.castells@udl.cat	6	
COLOMINA GABARRELLA, M. NIEVES	neus.colomina@udl.cat	4,7	
DE LA TORRE RUIZ, M. ANGELES	mariaangeles.delatorre@udl.cat	,4	

## Learning objectives

### 128 Know the fundamentals of microbiology and parasitology

- o Transmit to the future doctor the idea of the complexity of the microbial world, its variability and its extreme importance when it comes to human health.
- o Learn an in-depth knowledge of the biology of microorganisms in molecular, genetic, biochemical, structural and physiological aspects.
- o Understand the growth of microbial populations and know the physical and chemical mechanisms of growth control
- o Understand the genomic variability of microorganisms and the main mechanisms of exchange of genetic information.
- o Understand the interactions between microorganisms and humans in an infectious process.
- o Know the different nutritional types of the different microbial groups

### 129 Know the main microbiological and parasitological diagnostic techniques and interpret the results

- o Describe the main techniques and different strategies for the manipulation, identification and characterization of microorganisms in a clinical laboratory.
- o Know how to prepare culture media for the growth of microorganisms, manipulate them and work in sterile conditions
- o Know how to isolate and identify microorganisms based on their morphological, physiological and biochemical properties
- o Know how to determine the sensitivity to antimicrobial agents with laboratory tests
- o Know how to transform a plasmid into bacterial cultures and design the subsequent selection of the bacteria that incorporate this plasmid.

o Know how to determine the presence of a viral infection using a diagnostic serological test

## Competences

### General Competences

B. SCIENTIFIC FOUNDATIONS OF MEDICINE:

CG 7. Understand and recognize the normal structure and function of the human body, at the molecular, cellular, tissue, organic and systems level, in the different stages of life.

### Specific Competences

128 Know the fundamentals of microbiology and parasitology

129 Know the main microbiological and parasitological diagnostic techniques and interpret the results

## Subject contents

### THEORETICAL PROGRAM

#### I. INTRODUCTION (1 hour)

1.1. THE WORLD OF MICROORGANISMS. Historical aspects. Microorganisms as causative agents of diseases: Koch postulates. Types of microorganisms. Prokaryotic and eukaryotic microorganisms: differences in cell organization. Relationships between viruses and other microorganisms.

#### II. BACTERIAN STRUCTURES (3 hours).

2.1. GENERAL MORPHOLOGICAL PROPERTIES OF THE BACTERIES. Components of the bacterial cell. Morphology of bacteria. Pleomorphism. Cell size. Cellular groupings.

2.2. THE SKY SURFACE: LULA BACTERIANA. Cell wall: structure in gram-positive and gram-negative bacteria. Functions of the wall. Synthesis of the wall. Extracellular materials. The capsule: clinical significance. Flagels. Other surface structures: fimbriae and pili.

2.3. THE MEMBRANE AND BACTERIAL CYTOPLASM. The cytoplasmic membrane. Ribosomes. The core. Chromosome replication and cell division. Other genetic elements. Reserve substances. Bacterial endospores.

#### III. MICROBIAN METABOLISM (2 hours).

3.1. CATABOLIC PROCESSES Nutritional types of microorganisms. Autotrophic and heterotrophic microorganisms. Energy fund. Aerobic and anaerobic breathing. Bacterial fermentations.

3.2. ANABOLIC PROCESSES AND METabolic REGULATION. Nutrient transport. General outline of biosynthetic mechanisms. Growth factors. Regulation of enzyme activity. Regulation of enzyme and other protein synthesis.

#### IV. BACTERIAL GENETICS (3 hours)

4.1. GENETIC VARIABILITY IN BACTERIES. Genotype and phenotype. Genotypic and phenotypic changes. Organization of the bacterial genome. Spontaneous and induced mutations. Main mutagenic agents. Phenotypic expression of mutations. Types of bacterial mutants.

4.2. GENETIC TRANSFER MECHANISMS AND BACTERIUM PLASMIDS. Genetic recombination in bacteria. Transformation: clinical relevance. Transduction. Bacteriophages: lytic and lysogenic cycles. Bacterial conjugation. Types of plasmids. Resistance factors: molecular and clinical aspects.

#### V. CONTROL OF MICROBIAN GROWTH (5 hours)

5.1. MICROBIAN GROWTH. The cell division cycle in bacteria and other microorganisms. Growth of microbial

populations. Stages of growth. Measurement of growth. Continuous growth. Growth in natural conditions. Influence of environmental conditions.

5.2. MICROBIAN ACTION OF CHEMICAL AND PHYSICAL AGENTS Physical agents. Heat sterilization. Other physical methods of control. Chemical agents: disinfectants and antiseptics. Optimal conditions of action of the disinfectants. Disinfectant inactivation. Microbial resistance to disinfectants.

5.3. CHEMOTHERAPY AGENTS Properties. Assessment of the chemotherapeutic effect. Antibigrams. Microbiostatic and microbicidal action. Growth factor analogs: sulfonamides. Synthetic chemotherapeutic agents. Antibiotics. Spectrum of action. Mechanisms of action of antibiotics. Inhibitors of wall synthesis. Inhibitors of protein synthesis. Antibiotics acting on the membrane. Other antibiotics. Chromosomal and extrachromosomal resistance to antibiotics.

## **VI. ECOLOGY OF MICROBIAN INFECTIONS (4 hours).**

6.1. RELATIONS BETWEEN HOSPEDATOR AND MICROORGANISM. Microbial flora of the human body. Flora opportunist. Pathogenicity and virulence. Virulence factors. Invasion of the guest. Surface adhesion. Penetration. Multiplication. Diffusion by the organism. Factors influencing invasiveness. Bacterial toxins. Exotoxins: properties and biochemical mechanisms of action. Endotoxins: structure and activities in the host organism. Superantigens. Genetic variability and microbial pathogenicity.

6.2. DEFENSE CONSTITUTIONAL MECHANISMS. Surface barriers. Phagocytes: polymorphonuclear monocytes, macrophages and leukocytes. Microbial mechanisms of survival in phagocytosis. Antibacterial chemical agents. Role of the complement. Inflammation.

6.3. IMMUNITY ACQUIRED FROM MICROBIAN INFECTIONS. Immunity acquired against bacterial infections. Interaction between the constitutive and induced mechanisms. Toxin neutralization. Immunity to viral infections. Interaction between virions and antibodies: neutralization. Immunity to fungal and parasitic infections.

6.4. MODULATION OF ANTIMICROBIAN IMMUNITY: PROFILAXIS. Vaccination with attenuated living organisms. Vaccination with purified antigens. Adjuvants. Passive immunity. Homologous antibodies: serotherapy.

## **VII. ANIMAL VIRUSES (4 hours)**

7.1. GENERAL CHARACTERISTICS OF ANIMAL VIRUSES. Structure of the viral particle. Characteristics of capsid and nucleic acid. Stages of the multiplicative cycle. Cultivation of animal viruses. Detection methods.

7.2. Pathogenesis and control of viral diseases. Factors affecting the sensitivity of the host. Cytopathic effects of infection. Types of evolution of viral infections. Antiviral chemotherapy: strategies and main agents. Interferon: mechanisms of action and clinical applications.

7.3. DNA AND RNA VIRUSES. Main groups and diseases produced. Mechanisms of multiplication. Tumor virus: molecular mechanisms of oncogenesis.

7.4. SATELLITE PRINTS AND VIRUSES. Prions as infectious particles. Mechanisms of propagation. Prion diseases. Satellite Viruses.

## **VIII. DIVERSITY OF CLINICAL INTEREST BACTERIES (7 hours)**

8.1 BACTERIAN TAXONOMY. Basic concepts. Criteria used. Classification of bacteria according to Bergey's Manual of Systemic Bacteriology.

8.2 ALPHA-PROTEOBACTERIS. Rickettsias. Morphological, biochemical and physiological aspects. Infectious cycle. Main species of clinical interest. Bordetella. General characteristics. Antigenic structure. Pathogenicity. Brucella. Morphological, biochemical and physiological aspects. Antigenic structure.

8.3. BETA-PROTEOBACTERIS. Neiserias. Morphological, biochemical and physiological aspects. Antigenic structure and variability. Virulence factors.

8.4. RANGE-PROTEOBACTERIS. Pseudomonas and related genera. Morphological, biochemical and physiological aspects. P. aeruginosa: general characteristics. Pseudomonals of clinical interest: Xanthomonas,

Moraxella, Acinetobacter, Flavobacterium. Enterobacteria. Morphological, biochemical and physiological aspects. Classification according to physiology and serology. General mechanisms of pathogenicity. Escherichia, Salmonella, Shigella, Yersinia, Klebsiella, Enterobacter, Proteus. Vibrionaceae and related bacteria. Vibrio cholerae: general characteristics; antigenic structure; mechanism of action of cholera toxin. Other species of medical interest of the genus Vibrio. Aeromonas. Habitat and pathology.

8.5. EPSILON-PROTEOBACTERIS: Campylobacter and Helicobacter. Morphological, biochemical and physiological aspects. Pathogenic species.

8.6. GRAM POSITIVES WITH LOW PERCENTAGE OF GC. Staphylococcus. Morphological, biochemical and physiological aspects. Antigenic structure. Toxin and enzymes. Pathogenesis and determinants of pathogenicity. Species of clinical interest: S. aureus and S. epidermidis. General characteristics. Streptococci. Morphological, biochemical and physiological aspects. Antigenic structures. Toxins and enzymes. Classification of streptococci: S. pyogenes, streptococci. of the viridans group, St. faecalis. Clinical implications. Immunity. Pneumococcus. Morphological, biochemical and physiological aspects. Antigenic structure. Bacillus. Morphological, biochemical and physiological aspects. B. anthracis, B. cereus. Clostridium Morphological, biochemical and physiological properties. C. tetani, C. botulinum, C. perfringens, C. difficile. Infection clinic. Botulism and tetanus. Mycosis by clostridia: germs involved. Pseudomembranous colitis. Mycoplasmas. Morphological, biochemical and physiological aspects. Main pathogenic species.

8.7. GRAM POSITIVES WITH HIGH PERCENTAGE OF GC. Corynebacteria. Morphological, biochemical and physiological properties. Species with clinical significance. Pathogenesis. Resistance and immunity. Diphtheria bacilli. Mycobacteria. Morphological, biochemical and physiological aspects. M. tuberculosis. Structure. Pathogenesis. Immunity and hypersensitivity. Non-tuberculous mycobacteria: clinical features and implications. M. leprae: Pathology. Actinomycetes. Morphological, biochemical and physiological aspects. Main pathogenic species. Actinomyces. Nocardia.

8.8. Chlamydia. Morphological, biochemical and physiological aspects. Development cycle. Antigens. Host-parasite relationships. Classification. Psittacosis. Venereal lymphogranuloma. Trachoma. Inclusion conjunctivitis. Mycoplasmas. Morphological, biochemical and physiological aspects. Main pathogenic species.

8.9. Spirochetes. Morphological, biochemical and physiological aspects. Treponema pallidum. Structure. Antigens. Diseases related to syphilis. Borrelia. Antigens. Pathology. Leptospira. Antigens. Pathology. Bacteroides. General characteristics.

## **IX. CLINICAL MICROBIOLOGY (2 hours)**

9.1. BIOLOGY OF MICROSCOPIC FUNGI. Structure. Biological cycles: asexual and sexual reproduction. Methods in Mycology. Transmission mechanisms and types of mycosis. Antifungals. Main fungi of clinical importance. Opportunistic fungal infections.

## **X. CLINICAL PARASITOLOGY (1 hour)**

10.1. BIOLOGY OF THE PARASITS Adaptations to parasitic life. Types of habitats of the different parasites. Input and propagation routes. Relations with the host. Immunology and treatments for parasitic infections. Main groups of unicellular parasites and helminths.

## **LABORATORY PRACTICE PROGRAM (20 hours)**

1. Preparation of culture media for the isolation of microorganisms. Sterilization and preparation of the material. Seeds. Liquid and solid crops.
2. Techniques for staining microorganisms. Optical microscopy. Observation of bacterial and fungal cultures
3. Identification of enterobacteria of medical interest through a gallery of biochemical tests
4. Other bacterial identification tests (catalase, coagulase, etc.)
5. Determination of the sensitivity of bacterial isolates to antibiotics (antibiogram)
6. Transformation of bacteria and selection of clones in plate

## 7. Serological test for the diagnosis of an animal virus: ELISA

### Methodology

To achieve the objectives and acquire the attributed competences the following activities will be programmed:

#### - Master classes.

Master classes will be performed with all students and the attendance is not required. They are intended to give an overview of the thematic content, highlighting those aspects that will be useful to them in their training as doctors.

Methodology: Master classes will be taught in person. However, depending on the circumstances, master classes will be taught telematically on-line, either by videoconference, power-point presentations with explanatory recordings, power-point presentations with written explanations. To manage the doubts, tutorials will be carried out using various telematic instruments (videoconferences, forum, written messages).

#### - Seminars.

These will be done with 1/5 of the students; they are mandatory and must be done in the corresponding group. The purpose of the seminars is to share the thematic contents, guide the learning process by avoiding dispersion, clarify doubts and establish a conceptual diagram.

Seminars will be taught in person. However, depending on the circumstances, they will be taught on-line. Students will prepare exhibitions and a synthesis work on different topics related to the subject.

#### - Laboratory practices.

These will be done with 1/5 of the students; they are required. Students who do not do 80% of the practices will not be evaluated.

Laboratory practices are designed to familiarize students with basic microbiological techniques (microscopy, identification and diagnosis of microorganisms, working under sterile conditions, determination of antibiotic sensitivity, etc.)

Methodology: it is 20/16 practical hours in the laboratory (depending on the situation in relation to the pandemic), with the support of on-line theoretical explanations.

### Development plan

The subject of Microbiological Bases of Infection, which is taught in the second year of the degree in Medicine, aims to train the students in the knowledge of the microorganisms biology that are important in infectious pathologies in humans, that is, viruses, bacteria and fungi. To these, the study of parasites will be added, although some are not strictly microscopic. Students are required to have a good knowledge base in Biochemistry and Cell Biology, all of which will be taught in the first year. The contents of the subject are closely related to those of the Immune System, which is taught in parallel in the second year. The contents of the subject are the bases on which the subject of Infectious Diseases is based, which will be taught in the fifth year.

The seminars will be delivered in person or online, depending on the circumstances, with one session of 2 hours per week for each group of students. The sessions are concentrated in approximately one month.

The practice sessions will be held in 4-hour sessions, for 5 consecutive days, in person, according to the circumstances marked by the pandemic, for each group.

### Evaluation

The final qualification will be the sum of the different aspects evaluated:

- The knowledge acquired in the theoretical classes will be evaluated in two written exams in the periods established by the Faculty. Each of the exams will represent **35% of the final grade**. The specific content of these will be quantitatively proportional to the number of hours spent in each of the blocks of theory classes. In this way, theory classes will represent 70% of the content to be evaluated in the sum of the two exams. Each of the two theoretical exams will be considered passed when the grade is at least 5 out of a total of 10. To pass the subject **it will be necessary to pass each of the theoretical exams**.
- The seminar sessions will account for 10%.
- An evaluation of all practical activities will be performed through a test and/or short questions based exam that will represent 20% of the final grade. To pass the practical activities it must be necessary to get at least a 5 out of 10.

## Bibliography

### Biology of microorganisms:

- MADIGAN, M.T., MARTINKO, J.M., DUNLAP, P.V. and CLARK, D.P: Brock. Biology of microorganisms (12th ed). Addison-Wesley, Madrid. (2009).
- PRESCOTT, L.M., HALEY, J.P. and KLEIN, D.A. Microbiology. (5th ed.). McGraw-Hill-Inter-American (2005). (There is a newer edition in English)
- SCHAECHTER, M., INGRAHAM, J. L. and NEIDHARDT, F.C. Microorganisms. Reverté Publishing House, Barcelona (2008)
- MURRAY, P.R. et al. Medical microbiology. (7th ed.). Elsevier. (2014).

### Clinical microbiology and parasitology.

- DAVIS, B.D., DULBECCO, R., EISEN, H.N. Y GINSBERG, H.S. Microbiology Treaty (4th ed.) Masson Ed., Madrid. (1996)
- GARCIA RODRIGUEZ, J.A. AND PICAZO, J.J. Medical Microbiology. (2 vol.). Mosby, Madrid. (1998).
- KONEMAN, E.W. et al. Microbiological diagnosis, text and color atlas. (6th ed.). Ed. Pan-American, Buenos Aires (2008).
- PRATS, G., Clinical Microbiology. Panamerica Medical Publishing House (2005).
- APT BARUCH, W. Human parasitology. Mc Graw Hill Education (2013) Support books for Practical Classes • DIAZ, R et al. Practical Manual of Microbiology. Mason S.A., Barcelona.
- LENNETTE, E.H. et al. (Eds.). Handbook of clinical microbiology. (4th ed.). Pan-American, Buenos Aires (1987).
- PRATS, G.P. Medical microbiology. Practice book and demonstrations. Doyma, Barcelona. (1993).

### Works on CD-ROM:

- SCHAECHTER, M. et al. Beginning Microbiology. Cogito Learning Media, New York.
- SMITH, K.C. Y KATZ, D.S. Microbiology for Seniors. Cogito Learning Media, New York. Interesting

### e-mail addresses

- <http://www.wsu.edu.8080/~hurlbert/index-htlm> and
- <http://www.bact.wisc.edu/microtextbook>. In both directions you can access a course in Microbiology.
- <http://www-micro.msb.le.ac.uk>. Server at the Department of Microbiology, University of Leicester (United



Kingdom). It contains a complete course in clinical microbiology and links for teaching Microbiology.

- <http://prenhall.com/divisiones/esmapp/brock>. Access to the 9th edition of the Brock Microorganism Biology book, with self-evaluation questions and links related to Microbiology.
- <http://fitzscipress.com/mdde>. Access to Salyers and Whitt's Textbook of Microbiology.