UNICAMILLUS

Degree in Medicine and Surgery

Integrated teaching: **Laboratory Medicine**
SSD: **BIOS-09A, MEDS-02/B, MEDS-03/A, MVET/03B**
Coordinator: Luisa **Pieroni** mail: luisa.pieroni@unicamillus.org
Total CFU: **8**

Module: **Clinical Biochemistry and Clinical Molecular Biology**
SSD: **BIOS-09A**
Professor**:** **Luisa Pieroni** (1 CFU) mail: luisa.pieroni@unicamillus.org
CFU: **2**

Module: **Clinical Pathology**
SSD: **MEDS-02/B**
Professors: **Giovanni Barillari** (1 CFU) mail: giovanni.barillari@unicamillus.org
Professors: **Silvia Consalvi** (1 CFU) mail: silvia.consalvi@unicamillus.org
CFU: **2**

Module: **Microbiology and Clinical Microbiology**
SSD: **MEDS-03/A**
Professors: Marco Cassone (2 CFU) mail: mailto:marco.cassone@unicamillus.org
CFU: **2**

Module: **Clinical Parasitology**
SSD: **MVET/03B**
Professor: **David Di Cave** (1 CFU) mail: dicave@uniroma2.it
CFU: **1**

PREREQUISITES
To understand the topics of this course, basic knowledge of chemistry, organic chemistry and biochemistry, as well as, of anatomy, physiology and general pathology is required.
Finally, knowledge of medical microbiology and the basics of immunology are an essential criterion. Even in the absence of a formal propedeuticity criterion, it is strongly advised to start the study of Laboratory Medicine only after having passed the abovementioned exams

LEARNING OBJECTIVES:
The integrated teaching of Laboratory Medicine is aimed at introducing the student to the logic and tools underlying the execution of the diagnostic tests of the Clinical Biochemistry, Clinical Pathology, Clinical Microbiology, Clinical Parasitology. At the end of the integrated teaching, the student will be able to apply diagnostic tests in the clinical practice, and to interpret and evaluate their results.

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LEARNING OUTCOMES

The learning outcomes expected from the integrated teaching of Laboratory Medicine are consistent with the provisions from the Bologna Process and are found within the Dublin descriptors as follows:

Knowledge and understanding:

At the end of the course, the student will demonstrate knowledge and understanding of: the basic principles to interpret laboratory data; sources of pre-analytical and analytical variation; principles of quality control; diagnostic databases and reference values; methodologies for dosing common enzyme markers and their diagnostic value, and also their use as organ biomarkers; water and electrolytes homeostasis; methods and principles for electrolytes dosing in clinical samples; methods and principles for evaluating blood gases; the impact of the acid-base equilibria in the development of pathologies, the main methods and applications of molecular biology and clinical diagnostics, the new developments of omics sciences and their potential clinical application

The student must: have learned the logic of the clinical use of laboratory tests, the interpretation of their results and their integration into clinical reasoning; knowing how to frame the biological marker in the context of evidence-based medicine; know the methodologies used for counting/ identifying the blood cells and investigating the most common erythocyte, platelet and leukocyte pathologies; have a notion of the mechanisms underlying the haemostatic and fibrinolytic process, as well as the main laboratory investigations used to define the patient's hemorrhagic or thrombotic risk; know the diagnostic tests useful for evaluating the immune response or the presence of an inflammatory state in the patient, and their main clinical indications; have knowledge of laboratory investigations relating to the most common acute or chronic liver diseases; know the most frequently used methodologies to assess kidney function and know how to interpret the results of the macroscopic, microscopic and chemical-physical examination of the urine sample; understand the results of diagnostic tests aimed at determining the level of glucose or the concentration of lipids in the blood, know the reasons behind their pathological changes, and knowing how to correlate the obtained data with the risk of vascular damage ; know the markers employed to highlight the presence of a tumor or monitor its stage of progression; have notions about the typing of blood cells, and the laboratory investigations preparatory to transfusions; being able to identify the conditions in which to apply therapeutic drug monitoring and understanding the results; know the characteristics and applications of laboratory investigations aimed at ascertaining the presence and nature of a voluptuous intoxication; being able to identify and apply laboratory tests useful for monitoring the health status of individuals who perform sporting activities at different levels, disclosing any health risk factors resulting from overexertion and/or trauma.

Upon completion of the module of Clinical Microbiology, students should be able to: 1) know the relevance of an appropriate diagnosis of infections; 2) define the pre-analytical tools essential for a proper collection, storing, transport and assessment of the biological samples to be tested for research, direct or indirect, of microbes ; 3) appreciate the importance of using new and updated technologies for an adequate diagnosis; 4) know the major microorganisms cause of infections in different organs and apparatuses, their interaction with the human body, and how to diagnose them.

At the end of the Clinical Parasitology module, the student will know the main parasites that can infect humans, as well as the techniques used in the diagnosis of parasitic diseases and the correlation between pathogen, clinical course of the disease and treatment.

Applying knowledge and understanding:
The general objective of the integrated course of Laboratory Medicine is the critical learning of the method of dosing biomarkers which are present in human body fluids, as well as their use in the diagnosis of pathological conditions . At the end of the integrated teaching, the student will be able to evaluate the results of a laboratory medicine test, critically using the reference value databases. Starting from the knowledge of the laboratory test and its result, the student will be able to learn how to: determine the presence of a disease or the predisposition to it; confirm the diagnosis already hypothesized through other instrumental methods and/or clinical semeiotics; define the prognosis of the disease; choose the appropriate therapy and monitor its effects.

Communication skills:
At the end of the integrated teaching, the student will be able to explain the laboratory analysis of the patient's specimen by dividing its various phases into logical steps. Ultimately, the student will be able to correlate specific biomarkers, and/or the presence of microbes, with the presence, or with the risk of developing, a disease.

Making judgements:
At the end of the integrated teaching, the student will be able to provide evaluations of the results obtained in a clinical laboratory, and understand the factors which influence laboratory tests.

Learning skills:
At the end of the integrated teaching, the student will acquire skills useful to deepen and expand their knowledge in the field of laboratory medicine, also through the consultation of scientific literature, databases, and specialized websites.

INTEGRATED TEACHING SYLLABUS

Clinical biochemistry and clinical molecular biochemistry

- Definition, limits and aims of Laboratory Medicine and its disciplines: clinical biochemistry and molecular diagnostics, appropriateness of laboratory medicine and diagnostic process
- General organization of the analysis laboratory from the request for analysis to the report: laboratory sectors, use of the laboratory, sources of variability, reference intervals, critical values in the pre-analytical and analytical phases, intra- and inter-individual biological variability, concepts of diagnostic sensitivity and specificity and their applications. Internal and external quality control, interpretation of results, POCT
- Types and collection of clinical sample and analytical groupings: Blood, urine, feces, liquor, hair and saliva.
- Main analytical techniques and instrumentation in the analysis laboratory and most common analytes.
- Balance of body fluids and electrolytes. Acid-base balance. Conditions associated with abnormal electrolyte composition or acid-base balance
- Molecular Biomarkers: characteristics, definition and interpretation.

- Plasma proteins and enzymes as biomarkers of tissue and organ damage
- Methods of preparation and analysis of proteins in clinical diagnostics (e.g., protein electrophoresis, immuno-detection and immunoassays of proteins protein arrays, LC-MS, etc)
- Analytical techniques to discriminate, identify and amplify nucleic acids and examples of clinical application: agarose gel electrophoresis, PCR, gene sequencing (Sanger method), hybridization (southern blot, northern blot, in situ hybridization, etc. .), recombinant DNA and microarray, molecular diagnostic tests (genetic and oncological diseases)
- Genome editing and concept of gene therapy in clinical application
- Introduction to omics sciences and the holistic approach, concepts of Genome, Transcriptome and Proteome
- Human Genome Project and genome annotations
- Next Generation Sequencing and clinical applications of gene sequencing
- Transcriptomics, RNA sequencing
- Proteome analysis and clinical applications

Clinical Pathology

- Clinical value of the laboratory
- Injury and function markers
- Blood count test
- Markers of inflammation and immune reactions
- Coagulation and pathologies of the coagulation system
- Diagnostics of anemias
- Liver function tests and jaundice
- Glycemia
- Lipemia
- Renal function tests and urinalysis
- Immunohematology and transfusion medicine.

Clinical Microbiology

- Principles of medical microbiology and immunology
- Basic principles of microbiological diagnosis.
- Knowledge of laboratory tests used for the purpose of microbiological diagnosis.
- Definition of sample appropriateness and pre-analytical protocols
- Biological specimens suitable for microbiological diagnosis: Collection and storage of biological specimens for diagnostic purposes; Interpretation of microbiological test results.
- Elements of Microbiological Diagnostics: direct and indirect testing, microbial isolation, principles, purpose and interpretation of antibiotic susceptibility testing
- Elements of Virological Diagnostics: direct and indirect tests, viral isolation.
- Fungal Identification Methods and Strategies
- Main etiological agents, sampling and testing methods, interpretation of results for:
  - Central nervous system infections.
  - Respiratory tract infections.
  - Gastrointestinal infections and Food Toxins.

Urinary tract infections.
Infections in pregnancy.
Sexually transmitted infections.
Mycobacterial infections.
Systemic infections and sepsis.
HIV and hepatitis.
Infections in the immunocompromised patient
Hospital-acquired infections.

Clinical Parasitology

- Concepts of ecology applied to parasitism;
- General clinical parasitology principles regarding transmission routes, zoonosis, anthropozoonosis;
- Medically important Parasites belonging to Nematodes and Cestodes. Laboratory diagnosis of parasitic diseases, clinical symptoms and treatment

COURSE STRUCTURE

The course consists of formal lectures and seminars. The teachers use didactic tools such as powerpoint presentations with explanatory text, diagrams, illustrations and images pertaining to the above topics. Attendance is mandatory, according to the rules established by the secretariat for the students. Seminars are presented during regularly scheduled lecture hours and are dedicated to in-depth presentations on recent advances in knowledge and practice in selected key course topics. Lectures and seminars will enhance and complement, not substitute for, the information provided in the textbooks.

The final exam will focus on all the topics listed in the programme, independently of whether it has been discussed at the lessons.

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COURSE GRADE DETERMINATION

The exam consists of a written test with multiple-choice questions. Each question has one correct answer, and there is no penalty for wrong answers. Additionally, an oral exam is required only under specific conditions requiring additional assessment described below.

The student will have to answer 18 questions for each 2CFU module and 9 questions for the 1CFU module, for a total of **63 questions**, in **one hour time**. Each correct answer will be worth 0.5 points. The written test is considered passed if the student achieves a sufficient score in all modules, which means correctly answering **at least 50% of the questions plus one** in each module.

After all students have finished the test, the commission will review it. Results will be provided through the university's web app and oral examinations will occur on the same day. If many students are required to take the oral exam, they will be organized into groups alphabetically and scheduled for their exams on following days.

An oral exam will only be held under the following circumstances:

- It can be requested by students who have passed the written test and wish to improve their grade. The format and subject of the oral exam will be decided by the examining board based on the results of the written test.
- The examining board may require it for students who are on the verge of passing, with a borderline score in a maximum of two out of four modules. The exam is considered **failed** for any student who refuses to be questioned.

During the oral exam, students will have the opportunity to demonstrate their knowledge by discussing course topics, reasoning about related issues, and showing that they can express themselves using appropriate scientific language.

The final grade is a single, comprehensive score for the entire integrated course. A passing grade is achieved by successfully completing the entire exam with a score of **18 out of 30** or higher. The score obtained, even if positive, will not be valid for passing the test if the student has not passed each module (as described above).
If a student fails the integrated exam at a specific session, they must retake the entire exam at a later session.

The final exam grade will be calculated according to the following criteria:

Not suitable: Poor or lacking knowledge and understanding of the topics; limited capacity for analysis and synthesis, frequent generalizations of the requested contents; inability to use technical language.

18-20: Just sufficient knowledge and understanding of the topics, with obvious imperfections; just sufficient capacity for analysis, synthesis and autonomy of judgment; poor ability to use technical language.

21-23: Sufficient knowledge and understanding of the topics; sufficient ability to analyze and synthesize with the ability to reason with logic and coherence the required contents; sufficient ability to use technical language.

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24-26: Fair knowledge and understanding of the topics; discrete ability to analyze and synthesize with the ability to rigorously argue the required contents; good ability to use technical language

27-29: Good knowledge and understanding of the required contents; good ability to analyze and synthesize with the ability to rigorously argue the required contents; good ability to use technical language.

30-30L: Excellent level of knowledge and understanding of the required contents with an excellent ability to analyze and synthesize with the ability to argue the required contents in a rigorous, innovative and original way; excellent ability to use technical language

OPTIONAL ACTIVITIES

In addition to the frontal teaching activity, students can be received by individual teachers by requesting an appointment via email.

RECOMMENDED TEXTBOOKS

- **Clinical Pathology**:
  Laposata M, McCaffrey P. *Clinical Laboratory Methods: Atlas of Commonly Performed Tests*. Mc Graw Hill 2022

- **Clinical Biochemistry and Clinical Molecular Biology**:
  Michael J. Murphy & Rajeev Srivastava & Kevin Deans "Clinical Biochemistry", Sixth Edition , Elsevier

  Michael M. Cox, Jennifer Doudna, Michael O'Donnell. "Molecular Biology: Principles and Practice"; W H Freeman & Co; 2 edition

or

  Nader Rifai, Rossa W.K. Chiu. Ian Young, Carey-Ann D.Burnham, Carl T. Wittwer "Tietz Textbook of Laboratory Medicine." (7th Edition). Elsevier Health Sciences (US), Available from: VitalSource Bookshelf

  Supplementary teaching material provided by the instructor in the form of scientific articles and appropriate online sources, designed to complete, deepen, and update the topics covered in class.

- **Clinical Microbiology**
  Clinical Microbiology, Murray, Rosenthal, Pfaller, 9th or 10th Edition.

or

  Oxford handbook - "Infectious diseases and microbiology" E. Moran, F Cooke, 3rd edition

or

  Bailey & Scott 's Diagnostic Microbiology "Diagnostic Microbiology, 15th or 16th

Edition”

or

Koneman's Color Atlas and Textbook Of Diagnostic Microbiology- Gary W. Procop, Deirdre L. Church, Geraldine S. Hall - 2020

or

Wolters Kluwer – “Color atlas and textbook of Diagnostic Microbiology” – GW Procop, DL Church, GS Hall, WM Janda, EW Konemar, PC Schreckenberger, GL Wood – 7th Edition

For Consultation:

Harrison’s Principles of Internal Medicine, latest edition

- **Clinical Parasitology**

Textbooks for parasitology can be the same as those proposed for Clinical Microbiology