

MASTER OF SCIENCE IN LABORATORY MEDICINE

College of Medicine and Health Sciences | Departments of Microbiology, Pathology and Biochemistry

Track Credit Hours: 36

This Master of Science degree has three major areas of specialization, namely: Medical Biochemistry, Medical Microbiology and Immunology, and Pathology (Haematology).

1. Program Overview

The Master of Science in Laboratory Medicine Program consists of 36 credit hours: 28 hours of coursework and an 8-credit thesis. This is a two-year program organized as follows:

The curriculum is organized into four semesters (16 weeks in duration each). The first semester consists of core courses organized in five modules, while the second semester is devoted to specialized courses. The first two semesters are spent in formal classroom and laboratory learning. Interactive resource sessions and laboratory activities allow the students to expand their knowledge, share experiences, acquire proficiency in laboratory technology, and learn about research methodology.

At the end of the second semester, students must achieve a GPA of 3.0 or higher to proceed to the thesis. During the third semester (second year, first semester), master's students complete two core courses and embark on a research project. The fourth semester (second year, second semester) is dedicated exclusively to the research project and thesis writing.

2. Study Plan

First Year (First Semester)		
CMMSMLM501	Principles of Laboratory Practice	2
CMMSMLM502	Basic Genetics	2
CMMSMLM503	Tissue and Cell Biology	4
CMMSMLM504	Host-Parasite Interactions	2
CMMS 604	Research Methodology	2
Total Credit Hours		12

First Year (Second Semester) Specialized courses in Medical Biochemistry

CMMSMLM 505	Carbohydrates	3
CMMSMLM 506	Lipids	2
CMMSMLM 507	Proteins and Nucleic Acids	2
CMMSMLM 508	Homeostasis and Body Fluids	3
CMMSMLM 509	Hormones and Biomarkers	2
Total Credit Hours		12

First Year (Second Semester) Specialized courses in Medical Microbiology & Immunology

CMMSMLM 510	Vector-Borne Diseases	3
CMMSMLM 511	Gastrointestinal and Foodborne Infections	2
CMMSMLM 512	Respiratory Tract Infections	2
CMMSMLM 513	Central Nervous System Infections	3
CMMSMLM 514	Sexually Transmitted Infections	2
Total Credit Hours		12

First Year (Second Semester) Specialized courses in Pathology (Hematology)

CMMSMLM 515	Nutritional Anemias	3
CMMSMLM 516	Hemolytic Anemias	2
CMMSMLM 517	Disorders of Myeloid Cells	2
CMMSMLM 518	Lymphocytic Disorders	3
CMMSMLM 519	Hemostasis and Immunohematology	2
Total Credit Hours		12

Second Year (First Semester): Core courses + Research

CMMSMLM 601	Principles of Molecular Biology	2
CMMS 621	Inferential Statistics and its Applications	2
Total Credit Hours		4

Second Year (Second Semester)	
Research Thesis	8
Total Credit Hours	8
Total Programme Credit Hours	36

3. Course Descriptions

CMMSMLM 501 — Principles of Laboratory Practice (2 CH)

This course offers an overview of major key concepts in laboratory sciences, including good laboratory practice, and laboratory safety protocols and statistics. Students will acquire skills in information technology and medical database searching, while exploring evidence-based concepts and laboratory management. Emphasis is placed on effective use of EndNote for research, as well as internal and external quality control measures in clinical labs. Topics such as evidence-based laboratory medicine, computational biology, and bioinformatics will be covered, alongside practical quality control strategies to ensure accuracy and reliability in laboratory results. This course prepares students for advanced roles in clinical and research laboratory settings.

CMMSMLM 502 — Basic Genetics (2 CH)

This course provides an in-depth exploration of molecular genetics, focusing on DNA structure, gene expression, and DNA polymorphisms. Students will acquire knowledge of prenatal diagnosis and population screening methodologies, as well as PCR for Alu polymorphism. Plasmids, transposons, and inheritance patterns are covered in the course, along with hands-on plasmid purification techniques. Students will also learn about the structure and function of chromosomes, comprehending how different genetic components contribute to biological functions. In order to facilitate applications in clinical diagnostics and genetic research, this course gives students the fundamental knowledge and laboratory skills necessary to examine genetic material.

CMMSMLM 503 — Tissue and Cell Biology (4 CH)

This course delves into fundamental concepts of cell biology, including cell aging, senescence, and regulation of the cell cycle. Students will explore

various cell types, tissues, and the extracellular matrix, with practical experience in viewing gross organ specimens and microscopic tissue examination. Key topics include cell differentiation, apoptosis, basic cell functions, and mechanisms of cellular transport. The immune system will be used as a model to understand cellular processes. The course also covers tissue processing in histopathology, stem cell differentiation, and the principles of cellular energy and metabolism, providing a comprehensive foundation in cellular and tissue biology.

CMMSMLM 504 — Host-Parasite Interactions (2 CH)



This course focuses on immunology and the body's response to infections, covering topics such as autoimmunity, host-parasite interactions, and immunity to viruses, parasites, and protozoa. Students will explore the roles of cytokines and chemokines in health and disease, as well as the spectrum of inflammatory responses to infection. The course includes practical components on testing for toxin activity and the responses of eukaryotic cells. By examining immune responses in various infection scenarios, students will gain a deep understanding of immune mechanisms, the pathogenesis of diseases, and how the body defends itself against a wide range of pathogens.

CMMS 604 — Research Methodology (2 CH)

This course provides an in-depth understanding of research methodology, focusing on the essential elements of conducting scientific research. Topics include defining research, study designs, and subject selection, as well as the development of statistical analysis plans. Students will engage in hands-on exercises for critical appraisal, learn to create research protocols, and explore scientific writing techniques. The course also covers intellectual property, ethical considerations, plagiarism, and literature reviews. Students will gain skills in planning research projects, formulating research problems, selecting appropriate data collection tools, and disseminating findings, equipping them with the necessary tools for successful research in various scientific fields.

CMMSMLM 505 — Carbohydrates (3 CH)

This course explores the biochemistry of carbohydrates and insulin, focusing on inherited disorders of carbohydrate metabolism. Students will learn about the diagnosis and self-monitoring of diabetes mellitus (DM), including various diagnostic tests such as GTT, GCT, HOMA-IR, HbA1c, and enzyme assays for G6PD and PK. The course covers the types and pathogenesis of DM, along with microalbuminuria, and the role of biomarkers like serum lactate and pyruvate. Additionally, students will study insulin, IGF-1, and IGF-BP3, along with the genetics of diabetes, providing a comprehensive understanding of its molecular and clinical aspects.

CMMSMLM 506 — Lipids (2 CH)

This course covers the biochemistry of lipid metabolism, focusing on fatty acid synthesis, oxidation, and ketogenesis. Students will explore the structure and classification of lipids, complex lipid metabolism, and the genetic factors contributing to obesity and dyslipidemia. The course addresses the cardiovascular complications associated with dyslipidemia and includes practical techniques for determining serum homocysteine levels, cardiac function, and plasma lipids. Students will also learn to interpret the role of plasma lipoproteins in health and disease, equipping them with the knowledge and laboratory skills necessary to understand lipid-related metabolic disorders and their impact on cardiovascular health.

CMMSMLM 507 — Proteins and Nucleic Acids (2 CH)

This course covers key biochemical concepts, including enzyme properties and regulation, as well as the roles of hemoglobin and myoglobin in oxygen transport. Students will study liver function tests and their diagnostic applications, alongside the use of HPLC for diagnosing blood disorders. The course also explores recombinant DNA technology and the production of recombinant proteins. Topics include inborn errors of amino acid metabolism, malabsorption, and malnutrition. Additionally, students will learn about

jaundice, its differential diagnosis, and its clinical significance, providing a comprehensive understanding of biochemical diagnostics and metabolic disorders relevant to clinical practice.

CMMSMLM 508 — Homeostasis and Body Fluids (3 CH)

This course focuses on laboratory techniques for analyzing body fluids, electrolytes, and blood gases, including osmometry, and the assessment of renal function. Students will explore water, electrolytes, and pH regulation, as well as acid-base disturbances. The course also covers the analysis of various body fluids such as CSF, peritoneal, pleural, and synovial fluids. Key laboratory tools like ion-selective electrodes (ISE) and electrophoresis for detecting oligoclonal bands are emphasized, along with their applications in diagnosing conditions like CSF rhinorrhea and paraprotein. Additionally, students will learn about amniotic fluid bilirubin analysis using Lilley's plot for fetal health assessment.

CMMSMLM 509 — Hormones and Biomarkers (2 CH)

This course explores the biochemistry and clinical relevance of various hormones and metabolic disorders, focusing on adrenal, gonadal, thyroid, parathyroid, and hypothalamo-hypophysial hormones. Students will learn about hormone-related disorders and diagnostic methods like TDM (Therapeutic Drug Monitoring), drug abuse detection, and the analysis of VMA and HIAA. The course covers advanced immunoassay techniques including MEIA, ECLIA, EIA, RIA, and immunoturbidimetry. Students will also study bone markers, bone metabolism, and osteoporosis, alongside vitamin D metabolism and deficiency. The role of tumor markers in diagnosing cancers is also included, equipping students with essential skills for endocrine and metabolic diagnostics.

CMMSMLM 510 — Vector Borne Diseases (3 CH)

This course focuses on the biology, pathogenesis, diagnosis, epidemiology, and immunity of vector-borne diseases, particularly Leishmaniasis and Malaria. Students will study the life cycles of various bacteria, viruses, parasites, and vectors, with hands-on laboratory experience including microscopic examination, and in vitro cultivation for *Leishmania*. The course also includes blood film preparation and other laboratory tests for malaria. Additionally, it covers host-parasite interactions, immunity, drug resistance, and strategies for prevention and control. Current vaccination approaches for vector-borne diseases are explored, providing students with a comprehensive understanding of these critical public health issues.

CMMSMLM 511 — Gastrointestinal and Food-Borne Infections (2 CH)

This course covers the microbial diseases affecting the gastrointestinal tract (GIT), focusing on infective diarrhea, viral gastroenteritis (GE), food poisoning, and viral hepatitis. Students will explore the pathogenesis of *Helicobacter pylori*, antibiotic susceptibility testing, and immunological workups in GIT diseases. Laboratory techniques include the Urea Breath Test, molecular and indirect detection of pathogens like *Clostridium difficile*, and virus detection through cell culture and microscopy. The course also emphasizes the investigation of stool samples using aerobic, anaerobic, and microaerophilic cultures for pathogens such as *Salmonella*, *Shigella*, *Campylobacter*, and *Helicobacter pylori*, alongside immunological detection methods.

CMMSMLM 512 Respiratory Tract Infections (2 CH)

This course provides an in-depth study of respiratory pathogens and their pathogenesis, focusing on both upper and lower respiratory tract infections caused by bacteria, fungi, and viruses. Students will learn about respiratory specimen processing, sputum slide examination, and detection techniques for viral

respiratory infections, including rapid methods and direct antigen detection by immunofluorescence. The course covers pneumonia, tuberculosis, and *Mycobacterium tuberculosis*, emphasizing molecular detection methods such as multiplex PCR, gel electrophoresis, and PCR-based resistance gene identification. Students will gain practical experience in lab techniques and discussions on interpreting PCR results, equipping them with key skills in respiratory microbiology diagnostics.

CMMSMLM 513 — Central Nervous System Infections (3 CH)

This course focuses on the microbiological aspects of central nervous system (CNS) infections, covering the laboratory diagnosis of various pathogens. Topics include the diagnosis of *Treponema pallidum* and neuro syphilis, CNS toxoplasmosis, and viral infections such as enterovirus meningitis and rabies. Students will explore immunopathogenesis, diagnostic techniques like the CMV antigenemia test, and the role of CSF viral culture in identifying pathogens. The course also includes molecular methods for diagnosing viral infections and the detection of bacterial CNS infections. Practical laboratory experience in culture, molecular diagnostics, and pathogen identification will equip students with essential skills for CNS infection diagnostics.

CMMSMLM 514 — Sexually Transmitted Infections (2 CH)

This course provides a comprehensive overview of sexually transmitted infections (STIs), focusing on both bacterial and viral pathogens. Students will study the classification, epidemiology, and laboratory diagnosis of various STIs, including Chlamydia trachomatis, herpes genitalis, and HPV, with an emphasis on PCR-based detection methods. The course also covers immunological assessment in HIV, laboratory testing for HBV as a sexually transmitted disease, and the processing of urogenital specimens. Topics such as vaginal discharge, bacterial vaginosis, and the diagnosis of cervicitis and urethritis are explored, equipping students with essential knowledge and laboratory skills for diagnosing and understanding STIs.

CMMSMLM 515 — Nutritional Anemias (3 CH)

This course provides an in-depth study of hematology, focusing on erythropoiesis, iron metabolism, and the lab diagnosis of iron deficiency. Students will learn about assays for serum iron, total iron-binding capacity (TIBC), ferritin, as well as cobalamin and folate metabolism, including tests for serum cobalamin, folate, and homocysteine levels. Topics include pernicious anemia, polycythemia, and the use of erythrocyte and reticulocyte indices in diagnosis. Case studies and smear morphology are integrated for practical learning. The course also covers quality assurance and control methods in routine hematology labs, emphasizing the accuracy and reliability of lab diagnostics for nutritional anemia.

CMMSMLM 516 — Hemolytic Anemias (2 CH)

This course focuses on the structure, genetic control, and synthesis of hemoglobin, with a specific emphasis on genetic disorders such as hemoglobinopathies. Students will explore diagnostic strategies for thalassemia, including DNA separation, quantitation, and PCR techniques for alpha and beta thalassemia. The course covers laboratory methods such as HPLC for diagnosing hemoglobinopathies, morphologic diagnosis of hemolytic anemias, and testing the quality of PCR products. Practical skills include DNA purification, PCR, electrophoresis, and RFLP for alpha thalassemia, along with the interpretation of results. The course also includes advanced diagnostic methods, such as the reverse dot-blot strip assay for thalassemia.

CMMSMLM 517 — Disorders of Myeloid Cells (2 CH)



This course covers the biology and diagnosis of myeloid disorders, focusing on myelopoiesis, neutrophil function, and myeloid-associated antigens. Students will learn bone marrow biopsy processing, staining, histology, and immunohistochemistry techniques for diagnosing hematologic conditions. The course explores abnormalities in leukocyte counts, acute myeloid leukemia (AML) classification, and the use of flow cytometry in AML diagnosis. Topics also include chronic myeloproliferative disorders such as CML, essential thrombocythemia, and myelofibrosis, along with the cytogenetics of myeloid leukemias. Additionally, students will study myelodysplastic syndromes, including their classification and laboratory diagnostic approaches, providing a comprehensive foundation in hematologic diagnostics.

CMMSMLM 518 — Lymphocytic Disorders (3 CH)

This course provides an in-depth exploration of lymphocyte biology, focusing on B, T, and NK cells, immunoglobulins, and antigen receptor gene rearrangements. Students will study the structure and function of lymphoid organs and tissues, along with the classification and diagnosis of malignant lymphomas and lymphoid neoplasia, including leukemia. The course covers immune deficiencies such as AIDS, immune dyscrasias like multiple myeloma and amyloidosis, and the assessment of immunoglobulins. Techniques in leukemia cytogenetics and flow cytometry for diagnosing lymphoid malignancies will be explored, alongside the use of immunohistochemistry for evaluating normal and neoplastic lymphocytes, providing comprehensive diagnostic skills in immunology and hematology.

CMMSMLM 519 — Hemostasis and Immunohematology (2 CH)

This course provides an in-depth understanding of blood transfusion practices, including the overview of the process, components, and transfusion reactions. Students will learn about donor screening, blood component preparation, and pre-transfusion testing techniques such as blood grouping, compatibility testing, and screening for irregular antibodies. The course covers transfusion-transmissible infections, coagulation tests, and the structure and function of platelets. It also addresses bleeding disorders, both hereditary and acquired, and the physiology of blood coagulation. Additionally, students will study coagulation disorders and thrombophilia, focusing on their pathophysiology and laboratory diagnosis, providing essential knowledge for clinical hematology and transfusion medicine.

CMMSMLM 601 — Principles of Molecular Biology (2 CH)

This course aims to provide a comprehensive understanding of the fundamental concepts and current advancements in molecular biology. Students will explore the structure and function of biological macromolecules, including DNA, RNA, and proteins, and their roles in cellular processes. The course will cover key processes such as DNA replication, transcription, and translation equipping students with a deep understanding of how genetic information is stored and expressed. Furthermore, students will investigate practical techniques in DNA and protein analysis such as DNA extraction, agarose gel electrophoresis and SDS page electrophoresis, western blots, and the analysis of PCR products.

CMMS 621 — Inferential Statistics and its Applications (2 CH)

This is a core course designed to equip students with the fundamental statistical concepts to collect, summarize organize and present data and to draw meaningful conclusions from data. The primary objective is to develop a strong understanding of statistical inference, this involves learning various techniques such as estimation, confidence interval, hypothesis testing, various statistical tests (Parametric and nonparametric) and regression analysis. Through practical applications and real-world

examples using SPSS, students will gain the ability to analyze data critically, identify patterns, and make evidence-based interpretations.