

**MASTER'S DEGREE**

**IN**

**Clinical Laboratory Sciences (CLS)**

**(M.Sc.)**

**“Curriculum”**

## **Title: MASTER'S DEGREE IN MEDICAL LABORATORY SCIENCES (CLS)**

**Degree: M.Sc.**

### **Introduction**

Courses specific to Clinical laboratory sciences will be completed by applicants with a degree in clinical laboratory sciences prior to remainder of the curriculum. This is necessary both for the student to be sufficiently knowledgeable about the profession to practice in a Clinical laboratory sciences setting and to select a Masters Project.

These courses are predominately laboratory courses. Competency in the various laboratory techniques is necessary to function within the Clinical laboratory sciences.

The Clinical laboratory sciences major is designed to prepare students for certification in Clinical laboratory sciences. The program includes courses in the biomedical laboratory sciences, communications, and Clinical laboratory sciences coupled with clinical practicum experiences. It is designed to prepare graduates for certification and immediate employment in medical laboratories upon graduation by including a one-semester hospital laboratory experience.

### **Clinical Laboratory Sciences in the world**

Michigan state university clinical laboratory

KU Leuven and University Hospital Gasthuisberg, Belgium

Royal Melbourne Institute of Technology University (RMIT)

Hong Kong Polytechnic University

University of Alberta (UAlberta)

University College Dublin (UCD)

University of Cincinnati

Auckland University of Technology (AUT)

### **Definition**

The Clinical laboratory sciences are helpful in improving the quality and standard of life. Medical laboratory scientists are a vital part of the health care team; they perform laboratory tests to analyze body fluids, which aids in the diagnosis, treatment, and monitoring of disease. Seventy percent of healthcare decisions are made based on the results from medical laboratory tests.

The Clinical Laboratory Sciences (CLS) degree program combines basic and advanced theoretical knowledge with clinical practice. The curriculum fosters problem-solving and diagnostic abilities. In four-semester students will learn basic theories, skills and clinical practicum in the following areas:

- Immunology & Serology
- Immunohematology & Transfusion medicine
- Hematology
- Clinical Biochemistry
- Bacteriology
- Virology
- Parasitology
- Medical Mycology
- Clinical Laboratory (Quality management & Biosafety &....)
- Molecular Biology & Advanced Molecular Techniques
- Internal Medicine
- Internship
- Thesis

### **The aim of the courses**

The aim of our University is to prepare highly qualified graduates equipped to perform as laboratory professionals in a collaborative, diverse and rapidly changing health care environment. Students will be active participants in learning and developing into a competent, ethical professional. We prepare graduates who have a spirit of inquiry, a commitment to lifelong learning and service, and who are dedicated to advance the quality and availability of health care. Also to provide the highest quality Medical Laboratory Science programs and curricula that are recognized for excellence in preparation of diverse students who will be leaders in the laboratory profession.

### **General & specific competencies and skills for Clinical Laboratory Sciences**

Upon completion of the program, students will be able to conduct the following:

- Demonstrate entry-level competence in Clinical laboratory sciences.
- Practice principles of quality control related to laboratory practice.
- Apply all safety and governmental regulations and standards.

- Demonstrate problem-solving and critical thinking skills.
- Demonstrate professional and effective oral and written communication skills.
- Behave in an ethical, culturally-sensitive, and professional manner in a diverse environment.
- Describe and practice instructional techniques and terminology.
- Conduct a research project with faculty/mentor guidance.

The Clinical laboratory sciences professional program consists of two parts: didactic (classroom learning) and clinical (practice in the medical laboratory). After program completion, graduates should take an International certification examination.

### **The terms and conditions of admission to the course**

- Applying to Tehran University of Medical Sciences is online and electronically.
- All the applicants should have Bachelor's Degree in clinical laboratory sciences. Proficiency in written and speaking English. The students should provide a motivation letter. After applying, application will be carefully reviewed at the Office of Admissions.

### **Educational strategies, methods and techniques**

- Acquire information from demonstrations and experiences in courses, such as lecture, group and physical demonstrations.
- Identify information presented in accessible images from paper, slides, videos with audio description and transparencies.
- Use and interpret information from assessment techniques /procedures.
- Use and interpret information generated from diagnostic tools.
- Possess psychomotor skills necessary to perform or assist with day-to-day responsibilities commensurate with the student's discipline.
- Practice in a safe manner and perform universal precautions against contamination.
- Communicate effectively and sensitively with patients and families.
- Communicate effectively with faculty, preceptors, employees, other professionals and all members of the health care team during practicum, internship and/or other learning experiences.
- Measure, calculate, reason, analyze and synthesize data related to the diagnosis and treatment of patients and populations.

- Exercise proper judgment and complete responsibilities in a timely and accurate manner according to the medical laboratory science role.
- Synthesize information, problem-solve and think critically to judge the most appropriate theory, assessment, management or treatment strategy.
- Maintain mature, sensitive, effective relationships with clients/patients, families, students, faculty, staff, preceptors and other professionals under all circumstances
- Possess emotional stability to function under stress and adapt to rapidly changing environments inherent to the classroom and practice settings.

### **Student assessment**

Students should take part in exams in the end of each semester, for each course separately. Some lectures may decide to take an additional exam in the mid-term. An examination is an assessment intended to measure students' knowledge and skill. There are different methods of examination for theory subjects such as Multiple Choice Questions (MCQ), short answer questions, matching. For practical examination Objective Structured Practical Exam (OSPE) is performed.

### **Number and type of credits and table of the courses**

Clinical laboratory sciences education is a in two year's course.

A total of 33 credits is required for the degree with thesis. The student's program of study must be approved by the student's academic advisor.

Total Number of Credits: 33 credits

Core credits: 33

One credit is equal to:

- 17 hours Theory
- 34 hours practical
- 51 hours Internship

Code No.	Subject	Number of credits		Total credits
		Credit (theory)	Credit (practical)	
1	Immunology & Serology	2		2
۲	Immunology & Serology		1	1
۳	Immunoematology & Transfusion medicine	1		1
۴	Immunoematology & Transfusion medicine		1	1
۵	Hematology	2		2
۶	Hematology		2	2
۷	Clinical Biochemistry	2		2
۸	Clinical Biochemistry		2	2
۹	Bacteriology	2		2
۱۰	Bacteriology		1	1
۱۱	Virology	0.5		0.5
۱۲	Virology		0.5	0.5
۱۳	Parasitology	1		1
۱۴	Parasitology		1	1
۱۵	Medical Mycology	0.5		0.5
۱۶	Medical Mycology		0.5	0.5
۱۷	Clinical Laboratory	1	0	1
۱۸	Molecular Biology & Advanced Molecular Techniques	1		1
۱۹	Molecular Biology & Advanced Molecular Techniques		1	1
۲۰	Internal Medicine	2	0	2
۲۱	Internship	0	4	4
۲۲	Thesis	0	4	4
<b>Total</b>		<b>15</b>	<b>18</b>	<b>33</b>

**Title of the course:** MASTER'S DEGREE IN CLINICAL LABORATORY SCIENCES

**Number of Credits:** 33 credits

**Type of course:** Theory – Practical

**Principal objectives of the course:**

To engage in education and research that can contribute to society at both community and international levels, provide experiences for the development of expertise and ethics, and enrich humanity with relatively broader knowledge and deeper expertise in the next generation.

# Curriculum



## **Immunology & Serology**

**No. of Credits:** 2 Theory

**Code No.:** 01

### **General Description:**

This course is intended to provide the student with a foundation in immunology and serology. Topics include the components of the immune system, basic immunoassay principles and immunologic techniques and the clinical symptoms and laboratory findings associated with diseases and disorders of the immune system in the human body.

Serological procedures will be presented and their diagnostic significance will be emphasized. Discussions include monoclonal antibodies and enzyme immunoassay detection procedures used in microbial and/or immune disorders.

Also this course introduces students to the theoretical knowledge in cellular and molecular immunology in greater depth. Students learn about the development of the immune system, the components of the immune defense and the apparatus, functions and regulation of the cellular and humoral immune defenses in health and disease. Immunogenetics, transplantation immunology, immune tolerance, immune hypersensitivity; autoimmunity and immune diseases are special topic presented in this course. Students also learn about the use of immunological methods in diagnostics and biochemical analysis.

Medical Laboratory students will familiar with different routine methods include electrophoresis and gel diffusions. Familiarity with basis, types and mechanisms of immunological reactions, Types of immune system diseases and common tests to identify and to confirm them, new immunological tests, Clinical interpretation of immunological test results, new topics in the structure and function of the immunological system and quality control in the immunology tests.

Also this course provides up-date findings in the structure and function of the immune system, types of immune system diseases, novel findings in the immunological tests, immunological test to identify immunologic dysfunctions, auto immunity and immune deficiency, hypersensitivity and allergy, Tissue transplantation, infectious disease, and cancer.

<b>Session</b>	<b>Title</b>	<b>Hours</b>
<b>1</b>	Introduction to the Immune System	2
<b>2-3</b>	Foundations in Immunology: The Innate Immune System	4
<b>4-5</b>	Foundations in Immunology: The Adaptive Immune System	4
<b>6-7</b>	Microbial Pathogen-Immune System Interaction	4
<b>8-9</b>	Foundations in Immunology: Immunologically-Mediated Diseases	4
<b>10</b>	Current Topics In Immunology	2
<b>11</b>	Approach to the Evaluation of the Immunodeficient Patient	2
<b>12</b>	Immunodeficiencies at the Interface of Innate and Adaptive Immunity	2
<b>13-14</b>	Allergic Diseases	4
<b>15-16</b>	Systemic Immune Diseases	4
<b>17</b>	Vaccination	2
<b>Total</b>		<b>34</b>

#### **References:**

- Cellular and Molecular Immunology, Abul K Abbas, last edition.
- Roitt's Essential Immunology, Ivan M. Roitt, last edition.
- The Immune System, Peter Parham, last edition.
- Immunology, David Male, Stokes Peebles, Victoria Male, last edition.
- Clinical Immunology, Robert Rich, last edition.

## Immunology & Serology

**No. of Credits:** 1 Practical

**Code No.:** 02

### General Description:

This course introduces students to clinical laboratory practice in clinical immunology and serology. Topics covered include common serological tests such as agglutination reactions, precipitation reactions, complement fixation test (CFT), direct and indirect hemagglutination (HA and IHA), hemagglutination inhibition (HAI), Immune assay techniques (IFA, RIA, EIA, IHC, ELISA), the production of immune serum, labeling of antigens, commercial kits, immunodiffusion, immunoelectrophoresis, direct and indirect fluoroimmunoassays (FIA), chemiluminescence, skin test, flow cytometry immunophenotyping, QC in immunology department, and immunoblotting.

Session	Title	Hour
1-2	Basic immune serology tests	2
3-4	Flow Cytometry	4
5-6	Assessment of Functional Immune Responses	4
7-8	Assessment of Neutrophil Function	4
9-10	Assessment of Human Allergic Diseases	4
11	Lymphocyte isolation	2
12	Electrophoresis	2
13	SDS page electrophoresis	4
14	Immunofluorescence	4
15	Immunohistochemistry	2
16	Quality control in immunology test	2
<b>Total</b>		<b>34</b>

### References:

- Manual of Laboratory Immunology, L. E. Miller, last edition.  
Immunology & Serology in Laboratory Medicine, M.L. Turgeon, last edition  
Clinical Immunology, Robert Rich, last edition.

## Immunohematology & Transfusion Medicine

No. of Credits: 1 Theory

Code No.: 03

### General Description:

This course covering theory of transfusion medicine and serological procedures used in the evaluation of cellular antigen systems. Principles of immunology and genetics included as appropriate for the techniques performed; screening of donor units to provide a safe product discussed. Quality control and quality assurance issues considered.

### References:

- Technical Manual AABB. last edition.
- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.

Session	Title	Hours
1	<b>Erythrocyte Antigens and Antibodies</b>	2
2	Blood group systems	2
3	Rh group system	2
4	Platelets antigens	2
5	Neutrophils antigens	2
6	Alternative Blood group systems	2
7-8	<b>Blood Procurement and Red Cell Transfusion</b>	4
<b>Total</b>		<b>18</b>

## Immunohematology & Transfusion Medicine

No. of Credits: 1 Practical

Code No.: 04

### General Description:

This course is an introduction to the basic theory and concepts of antigen-antibody reaction as they pertain to blood cell transfusions. Blood group antigens and the genetics of their inheritance are examined. Methods are introduced for performing blood grouping, compatibility testing, and component selection.

### References:

- Technical Manual AABB. last edition
- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.
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Session	Title	Hour
1-2	Antigen antibody interaction tests	4
3-4	Complement role in hematology	4
5-6	Blood group typing	4
7-8	Preparation of Plasma-derived Biological products	4
9-10	Blood transfusion methods	4
11-12	Principles of apheresis	4
13-14	Applications and limitations of hemapheresis	4
15-16	Applications and limitations of plasmapheresis	4
17	Private blood transfusion	2
<b>Total</b>		<b>34</b>

## **Haematology**

**No. of Credits:** 2 Theory

**Code No.:** 05

### **General Description:**

In this course students become familiar with the formation, evolution, and distinction of blood cells, structure and mechanisms of hematopoietic tissues, maturation, kinetics, mechanism of action and metabolism of blood cells, identification of etiology, pathogenicity, and morphological abnormalities in blood disorders.

This course provides an introduction to hematology, an area of general pathology that is concerned with diseases that affect the blood, such as blood clotting disorders, anemias, lymphomas, leukaemias, thrombosis, coagulation disorders and haemoglobinopathies. Blood transfusion and bone marrow transplantation also will be discussed during the course. Lectures on diagnostic clinical hematology with emphasis on clinicopathological correlation. A course that introduces students to fundamental concepts in hematology, including the development of blood cell elements, normal physiology of blood cells, and their disorders. This course focuses on anemia, with a special emphasis on diagnosis. A course that consists of lectures and demonstrations in hematology with emphasis on coagulation and hemostatic disorders, white blood cell anomalies, and leukemia.

### **References:**

- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.
- McKenzie & Williams, Clinical Laboratory Hematology, last edition.

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<b>Session</b>	<b>Title</b>	<b>Hours</b>
<b>1</b>	Structure of the bone Marrow and the Hematopoietic Microenvironment	2
<b>2</b>	Erythropoiesis and Red Cell Turnover	2
<b>3</b>	Clinical Manifestations and Classification of Erythrocyte Disorders	2
<b>4</b>	Aplastic Anemia	2
<b>5</b>	Folate, Cobalamin, and Megaloblastic Anemias	2
<b>6</b>	Paroxysmal Nocturnal Hemoglobinuria	2
<b>7-8</b>	Thalassemia: A Disorder of Globin Synthesis	2
<b>9</b>	Erythrocyte Enzyme Disorders	2
<b>10</b>	Polyclonal and Hereditary Sideroblastic Anemias	2
<b>11-12</b>	Classification and Clinical Manifestations of Neutrophil Disorders	2
<b>13</b>	Disorders of Neutrophil Function	2
<b>14-15</b>	Monocytosis and Monocytopenia	2
<b>16-17</b>	Classification and Clinical Manifestations of the Clonal Myeloid Disorders	2
<b>18-19</b>	Classification, Clinical Manifestations, and Evaluation of Disorders of Hemostasis	2
<b>20-21</b>	Hemophilia A and Hemophilia B	2
22-23	Classification of Malignant Lymphoid Disorders	2
24	Plasma Cell Neoplasms: General Considerations	2
<b>Total</b>		<b>34</b>

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## **Haematology**

**No. of Credits:** 2 Practical

**Code No.:** 06

### **General Description:**

This course involves the study of blood cells in peripheral blood, bone marrow, and other body fluids. Concepts of normal blood cell maturation, physiology, morphological identification and review principles of blood cells in pathological conditions, automatic and manual counting of blood cells, making sure about the obtained data, and doing hemolytic and coagulation tests.

The course is intended to be an introduction to routine laboratory methods and instrumentation with correlation of laboratory observations with disease conditions. Competencies in hematological techniques conducted in pathology laboratories including, complete blood count, blood grouping, blood films, differential count, staining methods for microscopy, and coagulation tests will be assessed.

### **References:**

- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.
- Blood Cells an Atlas of Morphology with Clinical Relevance, G. Gulati, J. Caro, last edition.



<b>Session</b>	<b>Title</b>	<b>Hours</b>
<b>1</b>	Sampling and familiarity with various types of anticoagulants	4
<b>2</b>	Automated Blood Cell Analysis	4
<b>3</b>	Examination of the peripheral blood film	4
<b>4</b>	Red Blood Cell Morphology and Approach to Diagnosis	4
<b>5</b>	Flow Cytometric Analysis in Hematologic Disorders	4
<b>6</b>	Molecular Diagnostics in the Clinical Laboratory	4
<b>7-8</b>	Acute Leukemias: Morphology and Approach to Diagnosis	8
9	Myeloproliferative Neoplasms: Morphology and Approach to Diagnosis	4
10	Myelodysplastic Syndromes: Morphology and Approach to Diagnosis	4
11	Bone Marrow Examination	4
12	Normal Hemostasis and Coagulation	4
13	Hemorrhagic Disorders and Laboratory Assessment	4
14	thrombotic Disorders and Laboratory Assessment	4
15	Laboratory Evaluation of Hemostasis	4
16	Hemostasis and Coagulation Instrumentation	4
<b>Total</b>		<b>64</b>

## **Clinical Biochemistry**

**No. of Credits:** 2 Theory

**Code No.:** 07

### **General Description:**

At the end of this course, students should be able to name the body's biochemical compounds and their properties, describe the changes of these compounds in health and disease conditions, state the measurement value of each of these compounds in diagnosing various diseases.

Considering the graduates' type of work in medical diagnostic laboratories, an important part of each laboratory's workload is allocated to clinical biochemistry. Therefore, these graduates should be able to perform routine clinical biochemistry tests in medical diagnostic laboratories, which would be effective in diagnosing various diseases.

Students gain a deeper understanding of the links between physical and organic chemistry and biology. The fundamental concepts related to the central energy requirements and metabolism as well as the basic chemical properties and pathways that underlie metabolic processes are discussed. Emphasis is placed on how these pathways are integrated and regulated in the context of bioenergetics to maintain cell and whole body homeostasis in health and disease states. Students develop a good understanding of the most important recent developments and applications of biochemistry principles in targeting key molecules for therapeutic interventions. They also develop laboratory skills and critical thinking to study biochemical techniques.

### **References:**

- Harper's illustrated biochemistry, Last edition.
- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.

<b>Session</b>	<b>Title</b>	<b>Hours</b>
1-2	Biological fluid proteins and their pathological changes	2
3-4	Lipids, lipoproteins and atherosclerosis	2
5-6	Cytokines and their pathological changes	2
7	Biochemical tests to evaluate kidney and liver function	2
8-9	Clinical Chemistry of Endocrine Disorders	2
10	Electrolytes and blood gases and their pathological changes	2
11	Diagnostic value of changes in calcium, phosphate and magnesium	2
12-13	Vitamins and trace elements and their pathological changes	2
14	Biochemical tests to check hemoglobin, iron and bilirubin	2
15-16	Biochemical study of porphyrins and their metabolic disorders	2
17	Malignant diseases and their biochemical study	1
18	Biochemical studies of cerebrospinal fluid, amniotic fluid, gastric juice and pancreatic secretions	1
19	Clinical chemistry of pregnancy	2
20	Laboratory study of reproduction	2
21	Biochemistry of fertility and infertility	2
22	Clinical nutrition	2
23	Biochemical study of motor and neurological disorders	2
24	Clinical chemistry of aging	2
<b>Total</b>		<b>34</b>

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## **Clinical Biochemistry**

**No. of Credits:** 2 Practical

**Code No.:** 08

### **General Description:**

Important part of each laboratory's workload is allocated to clinical biochemistry. Therefore, these graduates should be able to perform routine clinical biochemistry tests in medical diagnostic laboratories, which would be effective in diagnosing various diseases. Correlation of laboratory results with clinical manifestation is also an integral part of these courses. This course covers all aspects of routine clinical chemistry testing, such as carbohydrates, electrolytes, acid-base balance, blood gases, nitrogen metabolites, proteins, enzymes, lipids and lipoproteins, calcium metabolism, liver function tests as well as some advanced topics (hormones, therapeutic drug monitoring, toxicology) and specialized techniques like chromatography (HPLC and GC).

### **References:**

- Davidson's Principles and Practice of Medicine, last edition
- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.

<b>Session</b>	<b>Title</b>	<b>Hours</b>
1-2	Sample Collection and Preservation	6
3-4	Spectrophotometry	6
5-6	Chemiluminescence	6
7-8	Electrophoresis	6
9-10	Chromatography	6
11-12	HPLC	6
13	Radioimmunoassay	4
14-15	Urine Analysis	6
16-18	DNA extraction	6
19	therapeutic drug monitoring	4
21	calcium metabolism	4
22	Blood gases	4
<b>Total</b>		<b>64</b>

- **Bacteriology**

**No. of Credits:** 2 Theory

**Code No.:** 09

**General Description:**

To become familiar with pathogenic bacteria, learn isolation methods, and determine their identity from different body samples. The study of different pathogenic bacteria and normal flora of human body including biochemical, antigenic, and morphologic features, factors affecting virulence and pathogenesis, clinical manifestations, epidemiology, and laboratory diagnosis.

This course covers classification structure and morphology of micro-organisms, nutritional requirements and growth, sterilization and disinfection, introduction to microbial genetics, collection and handling of clinical specimens, culture techniques for clinical specimens and expected pathogens, antibiotic sensitivity testing, and assay. A course that covers the characteristics of bacteria of medical importance with concentration on the diseases they cause, pathogenesis, mode of transmission, control and methods for isolation, identification, and interpretation of results. The course should provide basic knowledge of bacteria with special consideration to their importance within medicine.

**References:**

- Medical Microbiology, Jawetz Melnick & Adelbergs, last edition.
- Medical Microbiology, Murray, last edition.

Number	Subjects	Hours
۱	History of prokaryotes, structure, genum, metabolism, nutrition and reproductive of Bacteria	2
۲	Antibiotics & Classification	2
۳	Mechanisms of Antibiotic resistance in Bacteria	2
۴	Gram positive Cocci ( Micrococacea & Streptococacea ))	2
۵	Gram positive Bacilli (Corynebacterium, Listeria, Bacillus, Clostridium)	2
۶	Gram negative cocci and cocobacilli (Neisseria, Branhamella, Pasteurella, Francisella, Muraxella, Brucella, Heamophylus, Bordetella	2
۷	Enterobacteriaceae, Non fermenters gram negative bacteria(pseudomonas, Alcaligenes, Acinetobacter, stenotrophomonas, Kingella	2
۸	Anaerobic Bacteria and related infections (Actinomycetes, Streptomyces,...)	2
۹	Treponema, Burellia, Vibrionaceae, leptospira	2
۱۰	Mechanisms of gene Repair in Bacteria(Transposition, Transduction, Bacteriophage)	2
۱۱	Mycobacterium, chlamydia, Rickettsia	2
۱۲	Cloning in Bacteria, plasmid, Transposon, Mutation	2
۱۳	Helicobacter, Campylobacter, Mycoplasma, Legionella	2
۱۴	Bartonella, Gardenella, Sprillium	2
۱۵	Nosocomial Infections and agents	2
۱۶	Sterilization methods and disinfectant components	2
17	Final Exam	2
<b>Total</b>		<b>34</b>

## **Bacteriology**

**No. of Credits:** 1 Practical

**Code No.:** 10

### **General Description:**

Isolation and identification of bacteria in clinical samples. Ways of collecting clinical samples (urine, blood, CSF, throat secretions, genital tract secretions, and wounds), methods of direct microscopic examination of clinical specimens, culturing clinical samples considering sample type and sampling site, use of selective and enriched culture media, use of differential media, checking biochemical and serological characteristics to isolate and determine the type and species of bacteria in clinical samples, and determine sensitivity to antimicrobial compounds (antibiogram).

This course introduces basic practices and principles of diagnostic microbiology, focusing on pathogenic bacteria encountered in the blood, central nervous system, and genitourinary tract. It includes application of common algorithms for identification of clinically significant pathogens including aerobic gram-positive cocci, gram-negative bacilli, gram-negative cocci, gram-positive bacilli, and anaerobes.

### **References:**

- Bailey & Scott's Diagnostic Microbiology, P.Tille, last edition.
- Koneman's Color Atlas and Textbook of Diagnostic Microbiology, E. Koneman, last edition.



<b>Session</b>	<b>Subjects</b>	<b>Hours</b>
١	The procedure of wound discharge culture and diagnosis of staphylococci bacteria	4
٢	The procedure of Nasopharynx and Oropharynx discharge Culture and diagnosis of Streptococci bacteria	2
٣	The procedure of Sputum culture and diagnosis of pneumococci and other agents bacteria	4
٤	The procedure of liquid clinical Samples and detection of bacterial agents	2
٥	The procedure of Anaerobic culture Methods	2
٦	DNA extraction of Bacteria and preparing Buffers for PCR Method	4
٧	Stool Culture and diagnosis of Enterobacteriaceae family	4
٨	Urine Culture and diagnosis of UTI agents	4
٩	Antibiotic sensitivity tests (disc diffusion, MIC, MBC)	4
١٠	CSF Culture and diagnosis the Bacterial Meningitis, Detection of non-fermenter bacteria	4
<b>Total</b>		<b>34</b>

## **Virology**

**No. of Credits:** 0.5 Theory

**Code No.: 11**

### **General Description:**

Familiarity with the classification of various pathogenic viruses, pathogenesis mechanism of common viral diseases and common methods to diagnose them in laboratory. Also in this course, students get familiar with categorization and different groups of pathogenic viruses, and learn about diagnosis and treatment of viral diseases.

This course covers to know the main virus groups and the human viruses causing the most important diseases. Also, to know how different viruses utilize the target cell for amplifying their genomes and to expand in numbers, to know how viruses manage to expand within a host organism and avoid immune-mediated destruction, to know some fundamental mechanisms of viral-induced pathogenesis, and be able to account for general mechanisms: virus uptake, replication of the genome, synthesis and processing of RNA, gene regulation, protein synthesis.

Furthermore, be able to account for function of virus vaccines and antiviral means and for the use of virus as vector at gene therapy, newly discovered viruses' diagnosis, and how to get rid of viruses.

### **References:**

- Medical Microbiology, Jawetz Melnick & Adelbergs, last edition.
- Fundamentals of Molecular Virology, Acheson, Nicholas H., last edition.

<b>Time</b>	<b>Subjects</b>	<b>Hours</b>
1	History of Virology, Virus Classification RNA & DNA Viruses	1
2	Parvoviridae and Adenoviridae	1
3	Papillomaviridae and Polyomaviridae	1
4	Poxviridae and Hepadnaviridae	1
5	EBV, HSV1, HSV2, CMV, VZV	1
6	Orthomyxoviridae and Paramyxo Viridae	1
7	HIV, HTLV, Coronavirus	1
8	Flaviviridae and Togaviridae and Picornaviridae	1
<b>Total</b>		<b>8</b>

## Virology

**No. of Credits:** 0.5 Practical

**Code No.:** 12

### General Description:

In this course, students get familiar with the diagnosis of a viral infection is an important part of infectious disease management. Different tests will be carried out, and results and implications will be discussed.

Students can describe life cycles of dsRNA and ssDNA bacteriophages and recognize the differences and similarities in these viruses. Also, to learn and improve the practical virology techniques and laboratory work available in department, be able to account for the infection process on organism level for a number of medically important viruses, be able to make predictions about properties of newly discovered viruses' diagnosis, and have acquired practical laboratory experience in the field of molecular virology.

### References:

- Medical Microbiology, Jawetz Melnick & Adelbergs, last edition.
- Fundamentals of Molecular Virology, Acheson, Nicholas H., last edition.

Session	Subjects	Hours
१	Principle and Biosafety in Virology Laboratory	2
२	Sampling and transferring sample to Virology Lab, inject sample to Embryo egg	2
३	ELISA & Cell Culture Methods to detection of Viruses	2
४	Hemagglutination (HA) and Inhibition Hemagglutination (HI) Methods for detection of Viruses	2
५	DNA & RNA Virus Extraction in Clinical Samples	2
६	Blotting and Immunofluorescence techniques	2
७	Gene sequencing, PCR, RT-PCR Methods for detection of Viruses	2
८	Virus researches and work on small animal Lab	2
<b>Total</b>		<b>16</b>

## Parasitology

No. of Credits: 1 Theory

Code No.: 13

### General Description:

This course covers teaching morphologic and biologic characteristics of different intestinal and tissue parasites that are pathogenic to human.

The purpose of the course is to provide the basic principles and concepts of parasitic diseases and their laboratory diagnosis. Emphasis is placed on Protozoology, helminthology and entomology (morphology, life cycle, geographic distribution, pathogenesis, disease, routine, standard, and advanced diagnostic methods, epidemiology, prevention, and control of parasite). The important and mostly prevalent parasite disease.

### References:

- Medical Parasitology, Markell and Voge's, last edition.
- Basic Clinical Parasitology, Harold W. Brown, last edition.
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Session	Subjects	Hours
१	Introduction to Helminths , Trematoda, Liver flukes	2
२	Intestinal and lung flukes	2
३	Blood flukes and cercarial dermatitis	2
४	Cestoda, Taenia saginata, Taenia solium	2
५	Echinococcus spp. , Hymenolepis nana, Diphilobothrium latum, Sparganosis	2
६	Nematoda, Ascaris lumbricoides, Toxocara spp. ,Enterobius vermicularis , Visceral larva migrans	2
७	Hook worms, Strongyloides stercoralis, Trichostrongylus spp. , Trichocephalus	2
८	Introduction to protozoa, Nonpathogen amoeba	2
9	Entamoeba histolytica , Entamoeba dispar	2

<b>10</b>	GI and genital flagellates: Non pathogen flagellates, Giardia lamblia	<b>2</b>
<b>11</b>	Trichomonas spp. , Dientamoeba fragilis. Blood flagellates: Trypanosoma spp	<b>2</b>
<b>12</b>	Leishmania spp	<b>2</b>
<b>13</b>	Apicomplexa: Plasmodium spp	<b>2</b>
<b>14</b>	Toxoplasma gondii	<b>2</b>
<b>15</b>	Coccidia	<b>2</b>
<b>16</b>	Arthropoda: Lice, mite, Tick	<b>2</b>
<b>17</b>	Flea, Bug, Anopheles and Sand flies	<b>2</b>
<b>Total</b>		<b>16</b>

## **Parasitology**

**No. of Credits:** 1 Practical

**Code No.:** 14

### **General Description:**

Getting to know the different methods of identifying humans' pathogenic and non-pathogenic parasites. Teaching sampling methods, preparing slides to recognize different parasites, and studying the morphological characteristics of different kinds of helminths, and protozoans.

This course covers basic theory and clinical procedures used to isolate and identify intestinal, blood, and tissue parasites, including sampling- direct examination, staining and microscopical diagnosis of different specimen, principal of culturing the parasite- routine diagnostic methods, immunologic diagnosis- molecular diagnosis, and new approaches for detection of parasite infections.

### **References:**

- Medical Parasitology, Markell and Voge's, last edition.
- Basic Clinical Parasitology, Harold W. Brown, last edition.

<b>Session</b>	<b>Subjects</b>	<b>Hours</b>
၁	Demonstrations of Cestoda and Trematoda worms	2
၂	Demonstration of Nematoda worms	2
၃	Fixation Methods and sealing materials and Direct smear method	2
၄	OB tests and flotation Test , view samples containing worm eggs	4
၅	Demonstration of Sarcodina and Gi and genital flagellates	2
၆	Demonstration of Leishmania, Toxoplasma , coccidia	2
၇	Demonstration of Arthropods	2
၈	Formol ether concentration test, Sheaters sucrose Test	2
	Culture Methods of stool and blood , culture of special parasites	4
	Trichrome and Giemsa staining method	2
	Sampling of Leishmania wound, Serologic methods in parasitology	2
	New molecular methods in parasitology	4
	Work with laboratory animals	2
<b>Total</b>		<b>32</b>



## Medical Mycology

No. of Credits: 0.5 Theory

Code No.: 15

### General Description:

This course covers to recognizing and classifying saprophytic and pathogenic fungi. This course introduces human pathogenic fungi in terms of clinical symptoms, macroscopic and microscopic features, the study of their features on culture medium and with an emphasis on methods of identifying and isolating them from their surrounding environment (space, soil, devices and instruments, etc.), their differentiation, and the way of reporting.

A course that covers the different kinds and types of fungi (yeast and mold). This course discusses their disease spectrum mode of infection, gross requirements, and cultural and noncultural methods of identifications as well as antifungal drugs and susceptibility testing of fungi.

### References:

- Medical Mycology, Evans, last edition.
- Medical Mycology: The Pathogenic Fungi and the Pathogenic, J. W. Rippon, last edition.

Session	Subjects	Hours
1	General concepts of medical mycology and fungal diseases	1
2	The structure of fungi - Reproduction and Classification	1
3	Superficial fungal diseases	1
4	Cutaneous Mycoses	1
5	Subcutaneous Mycoses (1)	1
6	Subcutaneous Mycoses(2)	1
7	Visceral Mycoses (1)	1
8	Visceral Mycoses( 2)	1
<b>Total</b>		<b>8</b>

## Medical Mycology

No. of Credits: 0.5 Practical

Code No.: 16

### General Description:

At the end of this course, students should have the skill to take correct samples from patients, and isolate the effects of pathogenic fungi, and report them.

Also, to know them through laboratory methods, and getting familiar with research methods to confirm the existence of opportunistic mycosis diseases.

This session will be held in qualified laboratories which meet the essential criteria in term of proper scientific and technical management.

### References:

- Medical mycology: a practical approach., E G V Evans, last edition.

Session	Subjects	Hours
1	Vegetative and reproductive structures of fungi, common saprophytes	1
2	Causes of superficial fungal diseases	1
3	Causes of cutaneous fungal diseases (Trichophyton)	1
4	Causes of fungal skin diseases (microspora)	1
5	Causes of subcutaneous fungal diseases	1
6	Causes of subcutaneous fungal diseases	1
7	Causes of visceral fungal diseases	1
8	Sampling of skin, hair and nail lesions	1
<b>Total</b>		<b>8</b>

## **Clinical Laboratory**

**No. of Credits:** 1 Theory

**Code No.:** 17

### **General Description:**

Introduces the field of clinical laboratory science. Includes an introduction to the use and care of laboratory equipment and supplies. Provides basic concepts and technical skills necessary in the clinical laboratory field including safety, quality control (QC), laboratory testing and management.

This program focuses on the principles and applications of good statistical QC practices. Its aim is to explain how QC works, explain what errors interpretive rules are designed to detect, and suggests appropriate investigations for QC failures. Minimal mathematical or statistical theories are presented, as the emphasis is on practical and implementable practices and an explanation of why these practices are suggested.

Furthermore, explains how to implement QC strategy design principles, strategy considerations, explains how to utilize ongoing assessment of a QC program to optimize error detection, and describe how to work and maintenance the laboratory equipment.

In addition, the course offers a first complete analysis of biological risk, and an introduction on biosafety and biosecurity as sets of measures that can help manage biological risk. Examination aspects of laboratory operations to include quality assessment, troubleshooting, safety, laboratory mathematics, instrumentation and laboratory information systems. Also, other documents, are being issued in the areas of chemical agent and toxic industrial material detection equipment, decontamination equipment, personal protective equipment, and communications equipment used in conjunction with protective clothing and respiratory equipment.

### **References:**

- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.

## **Molecular Biology & Advanced Molecular Techniques**

**No. of Credits:** 1 Theory

**Code No.:** 18

### **General Description:**

Molecular Biology is central to current investigations to understand the genetic basis of human disease and pathology. In this course we will examine many different areas of cellular biology including: the synthesis and function of macromolecules such as DNA, RNA, and proteins; control of gene expression; membrane and organelle structure and function; bioenergetics; and cellular communication.

Familiar with the following Techniques: principals and methods of nucleic acid extraction (DNA/RNA), features of primers, methods and design tools, principals, basic, and advanced PCR techniques. Application of PCR in diagnosis of infectious and genetic diseases. Real Time PCR (RT-PCR), cDNA and their application in diagnosis. Brief introduction of the microRNA and its importance in diagnosis, Probes and their application in detection methods, FISH Western blot, Southern blot, Northern blot techniques. Also microarray and its application in medical diagnostic methods.

### **References:**

- Molecular Cell Biology, Lodish, last edition.
- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.

<b>Session</b>	<b>Subjects</b>	<b>Hours</b>
<b>1</b>	<b>DNA structure and function , DNA replication in prokaryotes and eukaryotes</b>	<b>2</b>
<b>2</b>	<b>DNA transcription and processing in Prokaryotes and Eukaryotes</b>	<b>2</b>
<b>3</b>	<b>RNA translation and gene expression controls</b>	<b>2</b>
<b>4</b>	<b>Cytoplasmic membrane and organelle structure and function; bioenergetics; and cellular communications.</b>	<b>2</b>
<b>5</b>	<b>DNA and RNA extraction in prokaryotes and Eukaryotes</b>	<b>2</b>

<b>6</b>	<b>PCR methods and application in diagnosis of infectious and genetic diseases</b>	<b>2</b>
<b>7</b>	<b>cDNA in RT-PCR and Real Time PCR, their applications in genetic diseases diagnosis</b>	<b>2</b>
<b>8</b>	<b>microRNA and genetic diseases diagnosis. Probes and in detection methods in FISH, Western blot, Southern blot, Northern blot techniques</b>	<b>2</b>
<b>Total</b>		<b>16</b>

## **Molecular Biology & Advanced Molecular Techniques**

**No. of Credits:** 1 Practical

**Code No.:** 19

### **General Description:**

Familiarity with extraction of human DNA/RNA and microorganisms. Analyzing and purifying DNA via defining OD. Performing PCR methods on extraction DNA and viewing.

### **References:**

- Molecular Cell Biology, Lodish, last edition.
- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.
- Molecular Diagnostic PCR Handbook, Gerrit J. Viljoen, last edition.

<b>Session</b>	<b>Subjects</b>	<b>Hours</b>
<b>1</b>	<b>DNA Extraction in prokaryotes and eukaryotes</b>	<b>4</b>
<b>2</b>	<b>RNA Extraction in prokaryotes</b>	<b>4</b>
<b>3</b>	<b>DNA Extracted and purification defining by OD</b>	<b>4</b>
<b>4</b>	<b>Extracted DNA PCR</b>	<b>4</b>
	<b>Gel electrophoresis of PCR product</b>	<b>4</b>
<b>5</b>	<b>Producing cDNA</b>	<b>4</b>
<b>6</b>	<b>RT- PCR method</b>	<b>4</b>
<b>7</b>	<b>Real Time PCR method</b>	<b>4</b>
<b>8</b>	<b>PCR results interpretation and analysis</b>	<b>4</b>
<b>Total</b>		<b>32</b>

## Internal Medicine

No. of Credits: 2 Theory

Code No.: 20

### General Description:

In this course, an overview of internal medicine is presented to students at a level that laboratory technicians need to coordinate with doctors for the correct interpretation of tests by emphasizing on Gastrointestinal (GI), Gynecology, endocrine, heart, lung diseases, and also Rheumatology and Dermatology.

Session	Title	Hour
1	Overview on Internal Medicine	3
2-3	A brief information on muscle , skeletal and connective tissue	3
4-5	A brief information on skeletal disease and mineral metabolism	3
6-7	Overview on kidney glomerular and non glomerular diseases	3
8-9	Lung disorders and treatment	3
10	Intestinal disorders and diagnosis	3
11	Liver and bile duct disorders and diagnosis	3
12	Overview on metabolic disorders	3
13	Endocrine disorders and diagnosis	3
14	Cardiac disorders and diagnosis	3
15	Overview on neurogenic disorders	4
<b>Total</b>		<b>34</b>

### References:

- Harrison's Principles of Internal Medicine, last edition.

## **Internship**

**No. of Credits:** 4 Practical

**Code No.:** 21

### **General Description:**

This course provides the final cooperative learning experience in an affiliated clinical facility. Students will gain their exposure to the clinical environment in a supervised application of learned theory and practice. Students will experience working with patients and performing procedures required of medical laboratory techniques. Specific detailed learning activities are developed to meet established clinical outcomes.

Also students will complete their internship in a supervised clinical setting. Specific detailed learned activities are developed to meet established clinical outcomes.

Selected practical experience emphasizing application of knowledge and skills to perform a wide variety of testing in a clinical setting and further develop discipline-specific competency in the major scientific disciplines of laboratory medicine, including hematology, clinical chemistry, microbiology, and immunohematology or pursuance of a clinical research study. Clinical case presentations and discussions aimed at test selection, disease-induced alterations, factors confounding interpretation, and practical experience in reception, cytogenetics, and histotechniques.

### **References:**

- Henry's Clinical Diagnosis and Management by Laboratory Methods, last edition.