

M.Sc. Medical Lab Technology

Programme Summary

Duration: 2 years

Eligibility

B. Sc MLT or Medical Microbiology or M Sc in Medical Sciences with minimum 50% marks in aggregate.

Program outcomes:

The mission of the Medical Laboratory Technology Program is to promote and maintain standards of quality for the services and the environment necessary for students to achieve their educational goals and to enhance the social, cognitive, and professional skills required for entry level employment as medical laboratory technicians (MLTs) in the healthcare community.

- Competency to perform a full range of testing in the contemporary medical laboratory encompassing pre-analytical, analytical, and post-analytical components of laboratory services, including hematology, biochemistry, microbiology, immunology, histopathology, cytopathology, serology, urinalysis, body fluids, molecular diagnostics, phlebotomy, and immunohematology.
- Learn proficiency to problem-solve, troubleshoot, and interpret results, and use statistical approaches when evaluating data.
- Effective communication skill to ensure accurate and appropriate information transfer.
- Appropriately and successfully collection of blood specimens through venipuncture, capillary puncture and body fluids.
- Identify basic guidelines for safe use of chemicals including proper labeling, protective measures, location and use of SDS, and disposal of hazardous chemicals.
- To gain knowledge of basic theory for primary aspects of the blood bank including antigen, antibody, compliment, agglutination, antiglobulin, ABO-Rh and other common systems, antibody identification, transfusion therapy, transfusion reactions, and hemolytic disease of the newborn.
- Demonstrate proper care and safe use of basic laboratory equipment including the microscope, centrifuge, pipets and glassware.
- Demonstrate proficient operation of instruments used in coagulation testing and demonstrate understanding of instrument maintenance and QC.
- Discuss the role of the phlebotomist and display professional behavior in dealing with patients, their family, and the public.
- Demonstrate integrity as shown by the admission and documentation of errors, recognition of the potential danger of short cuts, and the maintenance of patient and co-worker confidentiality.
- Adapt to stressful and/or new situations by maintaining composure and flexibility without compromising individual integrity.

Course outcomes:

S. No.	Course code	Course name	Maximum Marks	Course outcomes
1st semester				
1	MMLT 101	CLINICAL BIOCHEMISTRY	50+10	<p>This syllabus has been formulated to impart basics knowledge of biochemistry, apparatus, units, equipment, and volumetric analysis in the Clinical Biochemistry.</p> <p>Students will use current biochemical and molecular techniques to plan and carry out experiments.</p> <p>Learn the Principles of the assay procedures for biological materials such as Blood sugar, total protein, serum albumin, Serum Creatinine.</p> <p>Learn the different profile test such as lipid profile, thyroid profile, liver function, renal function test.</p> <p>Able to understand the concepts of Glucose tolerance test, Insulin tolerance test, Xylose absorption test, Analysis of calculi, composition and function of CSF clinical significance of CSF analysis.</p> <p>Learn the different techniques used in clinical biochemistry such as Immunochemical techniques, Molecular biology techniques, Protein and enzyme techniques, Centrifugation Techniques, Electrophoretic technique and Chromatographic techniques.</p>
2	MMLT 102	Biophysics and Human Physiology	50+10	<p>At the end of this course students able to use current Biophysical techniques to plan and carry out experiments. Demonstrate theory and practical skills of human physiology.</p> <p>Learn the role of biophysics with relation to Medical Laboratory Technology equipments.</p> <p>Learn fundamental of physics, Electricity and magnetism, Thermionic emission and its applications.</p> <p>Understand the concepts of history and development of X-ray tubes, high tension generators, control & indicating devices and principles of electronic circuiting.</p> <p>Learn the human physiology in details such as mechanism of muscle contraction, Cardiac cycle, mechanism of respiration, digestion and absorption of carbohydrate, fats and proteins, endocrine system, excretory system, reproductive system, skin and its functions, nervous system.</p>
3	MMLT 103	Immunology, Vaccinology and Transplantation	50+10	<p>At the completion of this course students able to understand the concepts of Immunology.</p>

		technology		<p>Learn the Immune system and immunity, history of immunology, composition and function of cells and organs involved in immune system, Immune responses, active and passive immunization, innate immunity and acquired immunity, determinants of innate immunity.</p> <p>Study in details the lymphocytes, their subpopulation, their properties and functions, membrane bound receptors of lymph cells, Helper T cells in immune response. Development and differentiation of B and T cells.</p> <p>Learn the hypersensitivity reactions, Defects in immune system, defects in complements, defective phagocyte mechanisms, vaccines and vaccine production, monoclonal antibodies and hybridoma technology.</p>
4	MMLT 104	Medical Microbiology	50+10	<p>After successful completion of this course students are expected to be able to:</p> <p>Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.</p> <p>Understand the structural similarities and differences among various physiological groups of bacteria/archaea.</p> <p>Understand the normal microflora of human body, Skin, Respiratory System, Gastrointestinal and Genitourinary tracts. Source of infection, mode of spread and portals of entry.</p> <p>Learn the Morphology, staining, culture, biochemical characteristics, lab diagnosis of Streptococci, Corynebacterium Diptheriae, Enterobacteriaceae- I (E.coli, Klebsiella and Enterobacter) , Enterobacteriaceae-II (Salmonella, Shiegella and Proteus),Pseudomonas; Vibriocholerae, Neisseria and Haemophilus etc.</p> <p>Learn the General characteristics, morphology and reproduction of medically important fungi.</p> <p>To the study of staining procedure of fungi and preparation, storing and processing of samples.</p> <p>To the preparation of KOH, Lactophenol, Cotton Blue etc.</p>

5	MMLT 105	Clinical Hematology and Blood banking technology	50+10	<p>After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.</p> <p>Learn ABO Blood Group System, its sub-groups, source of antigen, types of antibodies. Rhesus (RH) Blood Group System, its nomenclature and types of antigens, mode of inheritance, blood grouping and cross matching techniques , Coomb's test –direct and indirect test, titration of antibody.</p> <p>Understand the concepts of Blood collection- selection and screening of donor, collection of blood, various anticoagulants, and storage of blood.</p> <p>Learn Structure, collection and significance of bone marrow. Hemoglobin,its synthesis, functions and degradation. Abnormal haemoglobin and their means of identification and estimation. LE cell phenomenon and various methods of its demonstration , clinical importance .</p> <p>Able to demonstrate the Routine Haematological techniques. Use of different anticoagulants , Haemoglobin estimation and standarization , red cells indices , total leucocyte counts , platelets count , blood and bone marrow preparation , staining with leishman stains , MGG and Perl's stain , reticulocyte count , investigation of haemolytic anaemia etc.</p>
6	Practical Paper I	Laboratory course -I	60+20	To impart practical knowledge based on theory papers MMLT 101.
7	Practical Paper II	Laboratory course -II	60+20	To impart practical knowledge based on theory papers MMLT 102.
8	Practical Paper III	Laboratory course -III	60+20	To impart practical knowledge based on theory papers MMLT 103.
9	Practical Paper IV	Laboratory course -IV	60+20	To impart practical knowledge based on theory papers MMLT 104.
10	Practical Paper V	Laboratory course -V	60+20	To impart practical knowledge based on theory papers MMLT 105.
2nd Semester				

1	MMLT 201	Diagnostics Biochemistry and Organ Function Test	50+10	<p>The prime concern of this subject is to learn the Organ function tests- biochemical diagnosis and assessment of diseases of liver, kidney, pancreas, thyroid, muscle and CNS, and adrenals.</p> <p>Students will able to learn Enzymes and iosenzymes and their application in various disorders. Disturbances in acid-base balance. Lipoproteins and its disorders. Diabetes and atherosclerosis.</p> <p>To learn various biochemical diagnostics such as inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders. Learn cancer cytogenetics and its techniques such as karyotyping, PCR , blot diagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism, To the study of Chromosomal disorders, autosomal & sex chromosomal and its karyotype analysis.</p> <p>To learn the techniques G-banding, <i>in situ</i> hybridization (FISH and on –FISH), and comparative genomic hybridization (CGH).</p>
2	MMLT 202	Histopathology and Morbid Anatomy Technique	50+10	<p>This syllabus has been formulated to impart basics knowledge of General Pathology and Cytology of tumors:</p> <p>To learn the Pathology and Cytology of female genital tract. Cytology of normal respiratory tract. Cellular abnormalities due to benign disorders of respiratory tract. Importance of lung cancer screening and accuracy of pulmonary cytology.</p> <p>At the end of the course the students should be able to :</p> <p>To the students should be able to diagnose routine and complex clinical problems on the basis of Histopathology (Surgical Pathology) and Cytopathology specimens.</p>
3	MMLT 203	Cytology and Cytogenetics	50+10	<p>Students able to perform Cytologic Techniques: Preparation of direct or sediment smears, Cyto centrifuge preparation, Preparation cell blocks, Processing of haemorrhagic fluids, Methods of preparation of cell suspensions.</p> <p>To learn Enzyme cytochemistry; Acid and alkaline phosphatase and peroxidase. Methods of monoclonal antibody staining in smears</p> <p>Learn various different staining techniques for sex chromatin. Direct technique of chromosomal analysis in tumors and karyotyping.</p> <p>To learn working and applications of different types of microscope such as Light microscope, Phase contrast microscope, Electron microscope, Fluorescent microscope.</p> <p>After successful completion of this course students are expected to be able to: Demonstrate theory and practical skills in cytological techniques and their staining procedures.</p>

4	MMLT 204	Diagnostic Microbiology and Immunopathology	50+10	<p>After successful completion of this course students are expected to be able to know various culture media and their applications and also understand various physical and chemical means of sterilization , know general immuno techniques and microbial techniques.</p> <p>To learn basic about immunology, HLA, Major Histocompatibility Complex (MHC), To learn principles of Immunogenetics applied to MHC. Immunoglobulin and Paraproteins, Complement System,Tumor Immunology, Transfusion Reaction Learn basics principle of Immunohaematology. (Antigen, Antibody, structure of Immunoglobulin Molecule, Immune response, Immune antibodies and factors affectin antigen and antibody reaction).</p> <p>To know about basic genetics, Biochemistry, Characterization and Blood grouping procedure of Rh system. Other blood group (Lewis, MNSs, KELL, DUFFY and KIDD blood group systems and antibodies). Basic genetics, Biochemistry, Characterization and Blood grouping procedure of ABO blood group system.</p>
5	MMLT 205	Human Genetics and Human Genome	50+10	<p>After successful completion of this course students are expected to be able to: know about various hereditary diseases, Pedigree analysis, Human genome project. Know General cytostaining-techniques.</p> <p>To study History and development of human genetics; organization of the human genome,Genes and chromosome structure, function and inheritance, Repetitive DNA in human genome Alu and SINE repeats, functional organization of centromeres and telomerase and centrosomes. Know about Human genome mapping – genetic mapping, physical. mapping-restriction fragment length, polymorphism, pulse field gel electrophoresis, yeast artificial chromosome, bacterial artificial chromosomes, PI derived artificial chromosomes, expressed sequence tags, sequence-tagged sites. Micro satellites and single nucleotide polymorphism. Learn about various molecular techniques, Inherited human disease-single gene diseases, complete traits. Identification and isolation of disease genes- positional cloning, functional cloning, DNA and cDNA microarrays. Yeast two-hybrid system. Statistical methods for genetic analysis of complex traits, cancer genetics.</p>
6	Practical Paper I	Laboratory course -I	60+10	To impart practical knowledge based on theory papers MMLT 201.
7	Practical Paper II	Laboratory course -II	60+10	To impart practical knowledge based on theory papers MMLT 202.
8	Practical Paper III	Laboratory course -III	60+10	To impart practical knowledge based on theory papers MMLT 203.
9	Practical Paper IV	Laboratory course -IV	60+10	To impart practical knowledge based on theory papers MMLT 204.

10	Practical Paper V	Laboratory course -V	60+10	To impart practical knowledge based on theory papers MMLT 205.
3rd Semester				
Specialization in Hematology				
1	MMLT 301 (PH)	Clinical Haematology (Non-Neoplastic)	80+20	<p>After completion of this course students will acquire and demonstrate competency in laboratory safety and in routine and specialized pathology laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.</p> <p>Study to the mechanism of Hematopoiesis- origin and development of Blood cells, Role of Erythropoietin in Erythropoiesis, antigen independent and antigen dependent lymphopoiesis, Stages of megakaryocyte development and release of platelet, micro-megakaryocytes.</p> <p>Learn about the disorders of Red cell-Anemia, Immune hemolytic Anemia. Structural variants of haemoglobin, pathophysiology of structural haemoglobin variants, sickle cell Anemia with lab diagnosis, thalassemia including Alpha, Beta thalassemia, its pathophysiology and lab diagnosis Learn about the disorders White Blood Cells such as Neutrophilia, Luekemoid reaction, neutropenia, morphologic abnormalities of neutrophils, functional abnormalities of neutrophils, reactive eosinophilic and hyper eosinophilic syndrome, lymphocytosis, infectious mono nucleosis, lymphocytopenia.</p>
2	MMLT 302 (PH)	Clinical Haematology (Neoplastic)	80+20	<p>At the end of the course the students should be able to: Diagnose routine and complex clinical problems on the basis of clinical hematology. Blood and Bone Marrow examination and various tests related to the neoplasia. Learn about the Molecular genetic of myeloid leukemia's, CBF translocation, RAR translocation, Molecular genetic of lymphoid leukemia's, tel gene translocation, E₂A translocation, Molecular genetic of non-Hodgkin lymphomalignancies.</p>
3	MMLT 303 (PH)	Immunopathology and advance hematology techniques	80+20	<p>After successful completion of this course students are expected to be able to: Know various advanced immunotechniques such as FACS, Flow cytometry, PCR, FISH, Monoclonal antibodies formation.</p> <p>Study Basic Immunohematology: Blood group antigens, red cells membrane structure. Blood group antibody and complements, Erythrocytes antigen and antibody, ABO and Rh system and other red blood cells and antigen and antibody.</p> <p>Able to Blood collection, donor registration, donor selection, medical history, phlebotomy and donor reactions. Blood processing test: guideline for blood transfusion and testing, Pre transfusion testing, Artificial blood and blood substitute.</p> <p>To learn the different techniques used in immunehematology such as Flow cytometry, its principle and application of flow cytometry. Advance monoclonal antibody testing and procedures. Advance cytogenetic method and their hematologic application.</p>

				To learn the molecular genetic and its application in hematology.
4	Practical Paper I	Laboratory course -I	80+20	To impart practical knowledge based on theory papers MMLT 301.
5	Practical Paper II	Laboratory course -II	80+20	To impart practical knowledge based on theory papers MMLT 302.
6	Practical Paper III	Laboratory course -III	80+20	To impart practical knowledge based on theory papers MMLT 303.
Specialization in Biochemistry				
	MMLT 301 (BC)	Advances in Biochemical Sciences	80+20	After successful completion of this course students are expected to be able to know about Metabolism of Xenobiotics, Salicylate– Poisoning, Heavy Metals-Lead, Mercury, Zinc poisoning and preventive measures. Learn about the biochemical basis of disease, molecular basis of disease, Major classes of genetic disease, diagnosis and treatment, molecular medicine. Learn various Molecular Techniques & Bioinformatics: Polymerase Chain Reaction, Microarray, Blotting; Southern, Northern and Western Blotting, Immunofluorescence and Gel documentation. Gene annotation, DNA sequence data, Homology search of DNA and amino acids; Blast, Fasta, Human Genome Project, Application in Medical Science.
2	MMLT 302 (BC)	Intermediary Metabolism & Metabolic Disorders	80+20	At the end of the course the students should be able to: Oxidation and reduction, oxidases, Dehydrogenases, Hydroperoxidases, oxygenases and mono oxygenase. Learn about the basics of Carbohydrate Metabolism, metabolism of Glycogen, Glycogenesis, Glycogenolysis, Hormonal regulation, Regulation of Glycogen metabolism Learn about the basics of Lipid Metabolism: Lipid Transport and storage, Plasma Lipoproteins, Apolipoproteins, Lipoprotein metabolism, Clinical Significance of Lipoprotein. Learn about the basics of Amino Acid Metabolism: Amino acids, Biosynthesis and clinical significance of Polyamine, Nitric Oxide, Histamine, Serotonin, Melatonin, Creatinine, Melanin and GABA (Amino by tyrosine). Phenyl ketonurea, Tyrosinemia and other amino acid metabolic disorders. Introduction to nucleic acid metabolism, denovo and salvage pathway and disorders of purine and pyrimidine metabolism.
3	MMLT 303 (BC)	Diagnostic Enzymology	80+20	This syllabus has been formulated to impart basics knowledge of enzymology and students should be able to know general Characteristics, nomenclature and IUB enzyme classification (rational, overview and specific examples) introduction to the following terms with examples - Holoenzyme, apoenzyme, cofactors, co enzyme, prosthetic group, metalloenzyme measurement

				and expression of enzymatic activity, Enzyme assay activity units (I.U. and metal) Learn Enzyme Kinetics:Factor affecting enzyme activity enzyme concentration, substrate concentration, pH and temp. Derivation of michoulis maintain equation of unisubstrate reaction km and its significance, Kcat / KM and its importance, measurement of Km and Vmax line linevavarburk and other linear transformation, Bisubstrate reaction.
4	Practical Paper I	Laboratory course -I	80+20	To impart practical knowledge based on theory papers MMLT 301(BC)
5	Practical Paper II	Laboratory course -II	80+20	To impart practical knowledge based on theory papers MMLT 302(BC)
6	Practical Paper III	Laboratory course -III	80+20	To impart practical knowledge based on theory papers MMLT 303(BC)
Specialization in Microbiology				
1	MMLT 301 (M)	General Issues in Clinical Microbiology	80+20	Students able to learn Selection of Diagnostic Tests, Analysis of tests, Test – Verification and Validation, Bioassays of Vitamins and Antibiotics, Sterility test, Endotoxin test, Procedure and significances. Quality in the clinical Microbiology Lab – QC, QA program. Learn Statistical Analysis Of Microbiological Data And Research: Introduction to Mean, Mode, Median, Mean deviation, standard deviation, coefficient of variation correlation and Regression analysis. Learn Computer applications: Introduction to components of computers, Data storage devices, memory concepts, software and its types, Elementary idea to DOS- Applications of common packages – WINDOWS 3, 1, 95 and 98.
2	MMLT 302 (M)	Diagnostic Microbiology	80+20	At the end of the course the students should be able to perform: Biochemical tests for identification of bacteria. Molecular Mechanism of drug resistance, detection of antibacterial resistance, antimicrobial susceptibility testing Cultivation of anaerobic bacteria of medical significance. Able to perform various laboratory diagnosis of bacterial diseases – Diphtheria, Tuberculosis, Typhoid, Syphilis, Gonorrhoea, Urinary Tract Infections, Food Poisoning. Learn about Immunological techniques: - Immuno blotting, ELISPOT, Complement fixation,

				RIA and immuno fluorescence. Hypersensitivity reactions.
3	MMLT 303 (M)	Instrumentation & Techniques in Medical Microbiology	80+20	<p>After completion of this course students will acquire General Concept for specimen collection and handling. Lab physical Design and Organization – Lab Design with report to safety of air handing system, Mechanical system, walls, floors, ceilings and furniture, Institution. Organization of the Microbiology laboratory.</p> <p>Learn Preparation of stains – Gram, Alberts, Capsule, Spore, Ziehl, Neelsen, Lactophenol Cotton Blue, Preparation of reagents used in biochemical analysis.</p> <p>Learn basics Instrumentation Techniques: Centrifugation Basic principles and common centrifuges used in Laboratory. (Clinical high speed & ultra, Electrophoresis General Principal, application of Gel electrophoresis, PAGE, Agarose Gel elctrophoresis Spectroscopy UV – VIS absorption Spectroscopy, Flow Cytometry Principle and application.</p>
4	Practical Paper I	Laboratory course -I	80+20	To impart practical knowledge based on theory papers MMLT 301.
5	Practical Paper II	Laboratory course -II	80+20	To impart practical knowledge based on theory papers MMLT 302.
6	Practical Paper III	Laboratory course -III	80+20	To impart practical knowledge based on theory papers MMLT 303.
4th Semester				
Project Work	Maximum Marks	Course Outcomes		
The project will be based upon the research and actual bench work.	400	To develop skills for carrying out a research project and statistically interpret the outcomes and write the thesis. It will begin form the 3 rd semester and will continue through the 4 th one. The project report will be submitted at the end of the 4 th semester and evaluated.		