AMRITA SCHOOL OF MEDICINE

Amrita Centre for Allied Health Sciences

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CURRICULUM

MSc Medical Laboratory Technology

(Revised with effect from 2014-2015 onwards)

M.Sc Medical Laboratory Technology Page 1 of 46

Our Chancellor

SPIRITUAL PRINCIPLES IN EDUCATION

"In the gurukulas of ancient rishis, when the master spoke it was love that spoke; and at the receiving end disciple absorbed of nothing but love. Because of their love for their Master, the disciples' hearts were like a fertile field, ready to receive the knowledge imparted by the Master. Love given and love received. Love made them open to each other. True giving and receiving take place where love is present. Real listening and 'sraddha' is possible only where there is love, otherwise the listener will be closed. If you are closed you will be easily dominated by anger and resentment, and nothing can enter into you".

"Satguru Mata Amritanandamayi Devi"

M.Sc Medical Laboratory Technology Page 2 of 46

Introducing AIMS

India is the second most populous nation on earth. This means that India's health problems are the world's health problems. And by the numbers, these problems are staggering 41 million cases of diabetes, nearly half the world's blind population, and 60% of the world's incidences of heart disease. But behind the numbers are human beings, and we believe that every human being has a right to high-quality healthcare.

Since opening its doors in 1998, AIMS, our 1,200 bed tertiary care hospital in Kochi, Kerala, has provided more than 4 billion rupees worth of charitable medical care; more than 3 million patients received completely free treatment. AIMS offers sophisticated and compassionate care in a serene and beautiful atmosphere, and is recognized as one of the premier hospitals in South Asia. Our commitment to serving the poor has attracted a dedicated team of highly qualified medical professionals from around the world.

The Amrita Institute of Medical Sciences is the adjunct to the term "New Universalism" coined by the World Health Organization. This massive healthcare infrastructure with over 3,330,000 sq. ft. of built-up area spread over 125 acres of land, supports a daily patient volume of about 3000 outpatients with 95 percent inpatient occupancy. Annual patient turnover touches an incredible figure of almost 800,000 outpatients and nearly 50,000 inpatients. There are 12 super specialty departments, 45 other departments, 4500 support staff and 670 faculty members.

With extensive facilities comprising 28 modern operating theatres, 230 equipped intensive-care beds, a fully computerized and networked Hospital Information System (HIS), a fully digital radiology department, 17 NABL accredited clinical laboratories and a 24/7 telemedicine service, AIMS offers a total and comprehensive healthcare solution comparable to the best hospitals in the world. The AIMS team comprises physicians, surgeons and other healthcare professionals of the highest caliber and experience.

AIMS features one of the most advanced hospital computer networks in India. The network supports more than 2000 computers and has computerized nearly every aspect of patient care including all patient information, lab testing and radiological imaging. A PET (Positron Emitting Tomography) CT scanner, the first of its kind in the state of Kerala and which is extremely useful for early detection of cancer, has been installed in AIMS and was inaugurated in July 2009 by Dr. A. P. J. Abdul Kalam, former President of India. The most recent addition is a 3 Tesla Silent MRI.

The educational institutions of Amrita Vishwa Vidya Peetham, a University established under section 3 of UGC Act 1956, has at its Health Sciences Campus in Kochi, the Amrita School of Medicine, the Amrita Centre for Nanosciences, the Amrita School of Dentistry, the Amrita College of Nursing, and the Amrita School of Pharmacy, committed to being centres of excellence providing value-based medical education, where the highest human qualities of compassion, dedication, purity and service are instilled in the youth. Amrita School of Ayurveda is located at Amritapuri, in the district of Kollam. Amrita University strives to help all students attain the competence and character to humbly serve humanity in accordance with the highest principles and standards of the healthcare profession.

M.Sc Medical Laboratory Technology Page 3 of 46

Table of Contents
Part I – Rules and Regulations

M.Sc Medical Laboratory Technology Page 4 of 46

Part I
Rules and Regulations

M.Sc Medical Laboratory Technology Page 5 of 46

I. Post Graduate Programmes (Master of Sciences)

1. Details of Post Graduate Courses :			
Sl.No.	Course	Duration	Conditions of Eligibility for admission to the course
1	Medical Laboratory Technology (MLT)	2 years	Pass in B.Sc MLT (4 year regular courses only)
2	Neuro-Electro Physi-ology	3 years + 6 months Internship	B.Sc Physics
3	Swallowing Disorders and Therapy	2 years	BASLP
4	Clinical Research		MBBS.BDS/BAMS/BHMS/B.Pharm/BSc Allied Health Sciences/BSc Biotechnology/B.Sc Nursing/BSc in any Life Sciences
5	Biostatistics		Graduates in Statistics/Mathematics with paper in Statistics

M.Sc Medical Laboratory Technology Page 6 of 46

Program Outcomes (PO) (MSc MLT Biochemistry)

1. PO1: Deep knowledge on the subject.
2. PO2: Higher earnings.
3. PO3: Thorough knowledge in professional ethics.
4. P04: Good leadership qualities and team work.
5. PO5: Employability in many sectors.
6. PO6: Deep knowledge on research methodology.
7. PO7: Good communication skills.
8. PO8: Good teaching skills.

Program Specific Outcomes (PSO) (MSc MLT Biochemistry)

1. PSO1: Chemistry of Carbohydrates proteins and lipids, Enzymes and clinical enzymology, nd inborn error of metabolism, hormones
2. PSO2: Macro and micro minerals, Fat and water soluble vitamins, Molecular biology, immunology, Cancer and AIDS,nutrition
3. PSO3: Recent advances in clinical biochemistry – Biomedical instrumentation, energy metabolism, acid base balance , fluid and electrolyte balance
4. PSO4: Function tests- LFT, RFT,PFT, Cytogenetics ,techniques in genetics
5. PSO5: Practical Biochemistry- routine blood chemistry, analysis of body fluids,special tests-ELISA,Chemiluminensce techniques,immunoflurimetry,biosensors
6. PSO6: Knowledge in biostatistics, xenobiotics, experience in doing dissertation

M.Sc Medical Laboratory Technology Page 7 of 46

Program Outcomes (PO) (MSc MLT Microbiology)

1. PO1: Deep knowledge on the subject.
2. PO2: Higher earnings.
3. PO3: Thorough knowledge in professional ethics.
4. P04: Good leadership qualities and team work.
5. PO5: Employability in many sectors.
6. PO6: Deep knowledge on research methodology.
7. PO7: Good communication skills.
8. PO8: Good teaching skills.

Program Specific Outcomes (PSO) (MSc MLT Microbiology)

1. PSO1: Knowledge in General Microbiology
2. PSO2: Knowledge in Systematic & Diagnostric Bacteriology
3. PSO3: Knowledge in Medical Parasitology and Mycology
4. PSO4: Knowledge in Immunology
5. PSO5: Knowledge in Medical Virology
6. PSO6: Knowledge in Applied Mecial Microbiology and Recent Advances

M.Sc Medical Laboratory Technology Page 8 of 46

Program Outcomes (PO) (MSc MLT Pathology)

1. PO1: Deep knowledge on the subject.
2. PO2: Higher earnings.
3. PO3: Thorough knowledge in professional ethics.
4. P04: Good leadership qualities and team work.
5. PO5: Employability in many sectors.
6. PO6: Deep knowledge on research methodology.
7. PO7: Good communication skills.
8. PO8: Good teaching skills.

Program Specific Outcomes (PSO) (MSc MLT Pathology)

1. **P**SO1: Good knowledge about organization of a laboratory.
2. PSO2: Good knowledge about quality control measures, it's corrective and preventive actions & accreditation of laboratories.
3. POS3: Employability as technologist /Supervisor in various sectors and Research organizations.
4. POS4: Employability as teaching faculty.
5. PSO5: Entrepreneurship in Medical Laboratory Sciences.
6. PSO6: Good knowledge about principles and operations of all laboratory equipments
7. PSO 7: Skill in performing the special techniques in laboratory.
8. PSO 8: Core knowledge on Haematology, Cytology, Cytogenetics, Histopathology, Clinical pathology, Molecular biology, Blood banking and Immunolopathology.

M.Sc Medical Laboratory Technology Page 9 of 46

9. PSO 9: Ability to interpret the results.
10. PSO 10: Good knowledge about how to purchase equipments and chemicals to the laboratory.

I.2. Medium of Instruction:

English shall be the medium of instruction for all subjects of study and for examinations.

I.3. Eligibility:

Essential qualifications for eligibility are mentioned under clause No. I.

II. General Rules:

Admissions to the courses will be governed by the conditions laid down by the University from time to time and as published in the Regulations for admissions each year.

II.1. Duration of the Course:

Duration details are mentioned under clause No:I.1 of this booklet.

Weeks available per year	: 52 weeks
Vacation / holidays	: 5 weeks (2 weeks vacation + 3 weeks calendar holidays)
Examination (including preparatory)	: 6 weeks
Extra curricular activities	: 2 weeks
Weeks available	: 39 weeks
Hours per week	: 40 hours
Hours available per academic year	: 1560 (39 weeks x 40 hours)

Internship wherever specified are integral part of the course and needs to be done in Amrita Institute of Medical Sciences, Amrita School of Medicine, Kochi itself.

2. Discontinuation of studies

Rules for discontinuation of studies during the course period will be those decided by the Chairman /Admissions, Centre for Allied Health Sciences, and Published in the "Terms and Conditions" every year.

3. Educational Methodology

M.Sc Medical Laboratory Technology Page 10 of 46

Learning occurs by attending didactic lectures, as part of regular work, from co-workers and senior faculty, through training offered in the workplace, through reading or other forms of self-study, using materials available through work, using materials obtained through a professional association or union, using materials obtained on students own initiative, during working hours at no cost to the student.

4. Academic Calendar

Annual Scheme

FIRST YEAR

Commencement of classes	– August
First sessional exam	– 20 November - 30 November
Second sessional exam	– 20 February - 28 February
Model Exam (with practical)	– 15 May - 15 June (includes 10 days study leave)
University exam (with practical)	– 15 June -15 July (includes 10 days study leave)
Annual Vacation	– After the exam

SECOND YEAR

Commencement of classes	– August
First sessional exam	– 20 November - 30 November
Second sessional exam	– 20 February – 28 February
Model Exam (with practical)	– 15 May - 15 June (includes 10 days study leave)
University exam (with practical)	– 15 June - 15 July (includes 10 days study leave)
Annual Vacation	– After the exam

(For the successful completion of the course the students should complete the entire tenure of the course till 31st July in the parent departments)

III. Examination Regulations:

1. Attendance:

75% of attendance (physical presence) is mandatory. Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the final examination in each subject.

2. Internal Assessment:

M.Sc Medical Laboratory Technology Page 11 of 46

1. **Regular periodic assessment shall be conducted throughout the course. At least three sessional examinations in theory and preferably two practical examinations should be conducted in each subject. The model examination should be of the same pattern of the University Examination. Average of the two examinations and the marks obtained in assignments / oral / viva / practicals also shall be taken to calculate the internal assessment.**
2. **A candidate should secure a minimum of 35% marks in the internal assessment in each subject (separately in theory and practical) to be eligible to appear for the University examination.**
3. **The internal assessment will be done by the department thrice during the course period in a gap of not more than three months and final model exam which will be the same pattern of university examination as third sessional examination. The period for sessional examinations of academic year are as follows :**
    - **First Sessional Exam : November**
    - **Second Sessional Exam : February**
    - **Model Exam : May /June**

4. Each student should maintain a logbook and record the procedures they do and the work patterns they are undergoing. It shall be based on periodical assessment, evaluation of student assignment, preparation for seminar, clinical case presentation, assessment of candidate's performance in the sessional examinations, routine clinical works, logbook and record keeping etc.
5. Day to day assessment will be given importance during internal assessment, Weightage for internal assessment shall be 20% of the total marks in each subject.
6. Sessional examination as mentioned above and the marks will be conducted and secured by the students along with their attendance details shall be forwarded to the Principal (Result of the first sessional examination should reach before December 1st week of the academic year and result of the second sessional examination should reach to the Principal before March 1st week of the academic year)
7. Third sessional examinations (model exam) shall be held three to four weeks prior to the University Examination and the report shall be made available to the Principal ten days prior to the commencement of the university examination.

M.Sc Medical Laboratory Technology Page 12 of 46

3. University Examinations:

- University Examination shall be conducted at the end of every academic year.
- A candidate who satisfies the requirement of attendance, internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.
- One academic year will be twelve months including the days of the University Examination. Year will be counted from the date of commencement of classes which will include the inauguration day.
- The minimum pass for internal assessment is 35% and for the University Examination is 45%. However the student should score a total of 50% (adding the internal and external examination) to pass in each subject (separately for theory and practical)
- All practical examinations will be conducted in the respective clinical areas.
- Number of candidates for practical examination should be maximum 20 per day
- One internal and external examiner should jointly conduct the theory evaluation and practical examination for each student during the final year.

4. Eligibility to appear university Examination:

A student who has secured 35% marks for Internal Assessment is qualified to appear for University Examination provided he/she satisfies percentage of attendance requirement as already mentioned at the III (1) of the clause.

5. Valuation of Theory – Revaluation Papers:

1. Valuation work will be undertaken by the examiners in the premises of the Examination Control Division in the Health Sciences Campus.
2. There will be **Re-Valuation** for all the University examinations. Fees for revaluation will be decided by the Principal from time to time.
3. Application for revaluation should be submitted within 10 days from date of result of examination declared and it should be submitted to the office with payment of fees as decided by the Principal.

6. Supplementary Examinations:

Every main University examination will be followed by a supplementary examination which will normally be held within four to six months from the date of completion of the main examination.

As stipulated under clause No. 2 under Internal Assessment, HOD will hold an internal examination three to four weeks prior to the date of the University Examination. Marks secured in the said examination or the ones secured in the internal examination held prior to the earlier University Examination whichever is more only will be taken for

M.Sc Medical Laboratory Technology Page 13 of 46

the purpose of internal assessment. HODs will send such details to the Principal ten days prior to the date of commencement of University examination.

Students who have not passed / cleared all or any subjects in the first University examination will be permitted to attend the second year classes.

Same attendance and internal marks of the main examination will be considered for the supplementary examination, unless the HOD furnish fresh internal marks and attendance after conducting fresh examination.

Students of supplementary batches are expected to prepare themselves for the University Examinations. No extra coaching is expected to be provided by the Institution. In case at any time the Institution has to provide extra coaching, students will be required to pay fees as fixed by the Principal for the said coaching.

7. Rules regarding carryover subjects:

A candidate will be permitted to continue the next of the course even if he/she has failed in the first year university examinations.

IV. Criteria for Pass in University Examination - Regulations:

1. Eligibility criteria for pass in University Examination:

In each of the subjects, a candidate must obtain 50% in aggregate for a pass and the details are as follows:

- A separate minimum of 35% for Internal Assessment
- 45% in Theory & 35% in Oral / Viva
- A separate minimum of 50% in aggregate for Practicals / Clinics (University Examinations)
- Overall 50% is the minimum pass in subject aggregate (University Theory + Viva / Oral + Practicals + Internal Assessment)

2. Evaluation and Grade:

1. Minimum mark for pass shall be 50% in each of the theory and practical papers separately (including internal assessment) in all subjects.
2. A candidate who passes the examination in all subjects with an aggregate of 50% marks and above and less than 65% shall be declared to have passed the examination in the second class.
3. A candidate who passes the examination in all subjects in the first attempt obtaining not less than 65% of the aggregate marks for all the three years shall be declared to have passed the examination with First Class.

M.Sc Medical Laboratory Technology Page 14 of 46

4. A candidate who secures an aggregate of 75% or above marks is awarded distinction. A candidate who secures not less than 75% marks in any subject will be deemed to have passed the subject with distinction in that subject provided he / she passes the whole examination in the first attempt.
5. A candidate who takes more than one attempt in any subject and pass subsequently shall be ranked only in pass class.
6. A Candidate passing the entire course is placed in Second class / First class / Distinction based on the cumulative percentage of the aggregate marks of all the subjects in the I, II and III (Final) university examinations
7. Rank in the examination: - Aggregate marks of two year regular examinations will be considered for awarding rank for the M.Sc Graduate Examination. For the courses where the number of students are more than 15 rank will be calculated as under :
    - Topmost score will be declared as First Rank
    - Second to the topmost will be declared as Second Rank
    - Third to the topmost will be declared as Third Rank

V. General considerations and teaching / learning approach:

There must be enough experience to be provided for self learning. The methods and techniques that would ensure this must become a part of teaching-learning process.

Proper records of the work should be maintained which will form the basis for the students assessment and should be available to any agency who is required to do statutory inspection of the school of the course.

VI. Qualification of Examiner

There shall be two examiners – one internal and one external. The external examiner shall be drawn from other institutions where a similar course is being conducted. Both internal and external examiners should have MD /MSc MLT or MSc in concerned subject and should be full time teachers of Medical Laboratory Technology with at least two years teaching experience in the concerned subject.

Question paper setters

Question paper setters shall be posted from among the senior faculties of University. The Examiners and Question paper setters should be from the panel approved by University.

Setting of Question paper

All the question paper shall be of standard type. Each theory paper will be of 3 hours duration and shall consist of ten question carry equal mark with a maximum of 100 marks. Theory paper in all the subjects will consists of ten questions of 10 marks each or two sub questions in a ten mark main question.

VII. Research Guide

M.Sc Medical Laboratory Technology Page 15 of 46

1) Qualification of Guide
(i) Guide: Faculty in Medical Laboratory Technology / expert in the same Specialty with a minimum of 2 years' experience in teaching in the Post Graduate Programme in MLT and a minimum of 5 years of experience after Acquiring MD/M.Sc (MLT) degree.

(ii) Co-Guide: A Co-Guide is a Faculty/expert in the field of study.

(iii) Either Guide or Co-Guide should be a regular faculty in the concerned subject Having Post Graduate qualification in Medical Laboratory Technology.

2) Guide – Students Ratio
Maximum of 1:4 (including as co-guide)

3) Change of Guide – Guide may be changed only on unavoidable situations with prior permission from the University.

VIII. Dissertation

(1) Synopsis

Every candidate undergoing M. Sc (MLT) course shall carry out work on a selected research project under the guidance of a recognized guide. The results of such a work shall be submitted in the form of a dissertation. The dissertation is aimed to train a post-graduate student in research methods and techniques. It includes identification of problem, formulation of hypotheses, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis and comparison of results and drawing conclusions. Every candidate should submit a synopsis to the registrar of the University in the prescribed format containing particulars of proposed dissertation work after obtaining ethical clearance from the Institutional Ethical Committee comprising principal and senior professor of the college within nine months from the date of commencement of the course on or before the date notified by the university. The synopsis shall be sent through the proper channel. Such synopsis will be reviewed and the dissertation topic will be registered by the university.

(2) Dissertation submission

The candidate should submit their dissertation work at the end of 9 months of second year of the M.Sc.(MLT) course. The Scientific Committee of the college /Department should scrutinize and evaluate the dissertation work and make required correction if necessary and accept with modification before submitting to the university. Four copies of the dissertation work shall be submitted to the registrar on the 21st month of the commencement of course. Hall ticket for the second year examination will be issued to the candidate only after the submission of dissertation to the university.

(3) Dissertation Valuation

Dissertation valuation of the candidates will be conducted by the internal and external examiners together on the basis of work, presentation and defense viva at the time of second year M.Sc. (MLT) practical examination. The mark distribution is as follows.

M.Sc Medical Laboratory Technology Page 16 of 46

Project Content	200
Presentation	50
Defense Viva	100
Continuous Evaluation	50
Total	**400**

Part II

Syllabus

M.Sc Medical Laboratory Technology Page 17 of 46

INTRODUCTION

Scientific and technological advancements have created complexity in the diagnostic field necessitating advanced educational preparation. To keep pace with the tremendous progress in Medical Science and to meet changing health care needs specialization and research are essential in the field of Laboratory science. Specialties in which Post Graduate degree awarded by the University are as follows:

- M.SC(MLT) Microbiology
- MSC(MLT) Biochemistry
- MSC(MLT) Pathology

MAIN OBJECTIVES OF THE COURSE

Post Graduate programme in Medical Laboratory Technology (Biochemistry, Microbiology and Pathology) gives opportunity for specialized study in the field of Medical Laboratory Technology for B.Sc (MLT) graduates. Candidates who successfully complete M.Sc (MLT) course shall be able to

1. Learn theories and principles of Medical Laboratory science and Technology
2. Demonstrate the ability to plan and effect the change in laboratory practice and health care delivery system.
3. Setup and manage specialized clinical laboratories and to deliver better health care System to the public.
4. Practice as Specialized Technologists in the concerned subject.
5. Function as effective educators in the field of Medical Laboratory Technology
6. Conduct independent research works and utilize the research findings in Laboratory practice and education.
7. Evaluate various educational programmes in Medical Laboratory Technology.
8. Demonstrate interest in continued learning and research for personal and professional advancement.
9. Establish collaborative relationship with Clinicians and members of other disciplines.

M.Sc Medical Laboratory Technology Page 18 of 46

M.Sc MLT (BIOCHEMISTRY)

Paper	Subect	Theory hours	Practical hours	Clinical Laboratory Practice Hrs	Total hours
FIRST YEAR					
Paper-I	General, Biochemistry & Chemistry of Biomolecules	100 hrs	600 hrs	1250 hrs	2250hrs
Paper-II	Enzymology, Metabolism &Inborn errors of metabolism	100 hrs			
Paper- III	Vitamins & Hormones	100 hrs			
Paper- IV	General Physiology ,Nutrition &Mineral metabolism	100 hrs			
SECOND YEAR					
Paper -V	Molecular Biology & Immunology	100 hrs	300 hrs	1150 hrs	1650hrs
Paper -VI	Diagnostic Biochemistry, Recent advances in clinical chemistry and Biostatics	100 hrs			
	Dissertation				600 hrs
Total	First and second year including dissertation				4500hrs

PART- I (First year)

Paper – I - General Biochemistry and Chemistry of Biomolecules (MMLTB1)

CO1: Knowledge in the Chemistry of Carbohydrates proteins and lipids
CO2: Knowledge in the Chemistry of Enzymes and clinical enzymology
CO3: Knowledge in the Chemistry of inborn error of metabolism
CO4: Knowledge in the Chemistry of hormones

Chemistry of living things: Structure of cell Plant, animal, bacteria and virus. Nucleus, organelle, cell membrane. Structure and functions.
Water - a medium for living things. Universal solvent, hydrogen bonds, colligative properties. Preparation of high quality water.
Physical Chemistry: Viscosity, Surface tension, osmosis, Donnan membrane equilibrium, dialysis, diffusion, adsorption, partition coefficient - Principles and biochemical applications. Methodology: Photometry, spectrophotometry, fluorimetry, flamephotometry,
Atomic absorption spectrophotometry, osmometrynephelometry. Chromatography, electrophoresis, electrochemistry, Biosensors, chemiluminesence, Flow cytometry. Homogeni-

M.Sc Medical Laboratory Technology Page 19 of 46

zation, cell disruption, sonication, centrifugation and ultra centrifugation fractional distillation, solvent extraction, liophilization.
General concepts regarding laboratory wares and its standardization. Quantities and units: SI units- their advantages and disadvantages
Specimen collection, preservation and preparation for analysis, constituent stability, documentation and specimen flow system, interferences in the collection process. Anticoagulants and preservatives.
Regulations and precautions regarding transport of biological specimens. Biomedical waste disposal.
Electrolytes, pH and buffers- pH meter, pH measurement, buffers, biological buffers. Radioactivity: radioisotopes, ionizing radiations, measurement of radioactivity, applications of radioisotopes in clinical biochemistry and research, Storage and disposal of radioactive materials.
Biomolecules: Characteristics and properties.
Proteins: Classification, properties and chemistry of amino acids and proteins, structure of proteins amino acid sequencing of proteins.
Carbohydrates: Classification, Chemistry and properties. Lipids: Classification, Chemistry and properties.
Bio-membranes: Chemistry, structure, Transport process across bio-membranes.
Nucleic acids: chemistry and properties – purines, pyrimidines, nucleosides, nucleotides, nucleic acids, nucleoproteins, genes and Chromosomes.

Paper-II- Enzymology, Metabolism and Inborn Errors of Metabolism (MMLTB2)

CO1: Knowledge in Macro and micro minerals
CO2: Knowledge in Fat and water soluble vitamins
CO3: Knowledge in Molecular biology
CO4: Knowledge in immunology
CO5: Knowledge in fluid and electrolyte balance

Enzymes: Classification, co-enzymes, cofactors, mechanisms of enzyme action, factors affecting enzyme action, enzyme kinetics, enzyme inhibition, regulatory enzymes, enzyme immobilization, Clinical enzymology. , Applications of Enzymology
Metabolism: Bioenergetics, free energy, biological oxidations, electron transport, oxidative phosphorylation.
Carbohydrate metabolism: glycolysis, gluconeogenesis, uronic acid pathway, TCA cycle, HMP pathway, glycogen metabolism, galactose metabolism, fructose metabolism, Regulation of blood glucose
Aminoacid metabolism: Transamination, deamination, oxidative deamination, ammonia transport, urea formation
Metabolism of individual aminoacids
Biosynthesis of catacholamines, melanin formation, Nitrogen balance. Lipid metabolism: Fatty acid synthesis, fatty acid oxidation, ketogenesis.
Metabolism of triglycerides, phospholipids, sphingolipids, and cholesterol. Lipoprotein metabolism, obesity, fatty liver, lipotropic factors and ketosis, atherosclerosis and coronary heart disease.

M.Sc Medical Laboratory Technology Page 20 of 46

Purine,Pyrimidine metabolism: Biosynthesis of purine and pyrimidine nucleotides. Degradation of purine and pyrimidine nucleotides.
Hemoglobin metabolism: Heme synthesis, formation of hemoglobin, metabolism of bilirubin, urobilinogen, and other bile pigments.
Inborn errors of metabolism:
Inborn errors of carbohydrate, amino acid, lipid, purine and pyrimidine, heme and bilirubin metabolism – Defect in protein biosynthesis arising from genetic mutations. Enzyme abnormalities occurring in genetic disorders.The biochemical consequences of a primary enzyme block in a metabolic pathway and the ways in which clinical and pathological signs may be produced .Methods of detecting metabolic disorders. Methods of treatment.
Biological Fluids
Cerebrospinal fluid analysis
Amniotic fluid – Bilirubin, Creatinine,alpha feto protein, Lecitin / Spigomyelin ratio, Palmitate and other tests of fetal lung maturity.Screening for Down syndrome.
Urine Analysis – Normal and abnormal urine composition including abnormal pigments. Biochemical analysis of Peritoneal fluid, Pleural fluid, Synovial fluid, Semen etc.

Paper- III - Vitamins and Hormones (MMLTB3)

CO1: Knowledge in Recent advances in clinical biochemistry
CO2: Knlwledge in Biomedical instrumentation
CO3: Knowledge in energy metabolism
CO4: Knowledge in acid base balance
CO5: Knowledge in fluid and electrolyte balance

Vitamins: Classification of vitamins.
Chemistry, properties, biological importance and deficiency manifestations of fat soluble vitamins.
Chemistry, properties, biological importance, deficiency manifestations and coenzyme functions of water soluble vitamins.
Hormones: Classification of hormones, mechanism of hormone action, regulation of hormone secretion.
Chemistry, metabolism, biological functions and disorders of-
Hypothalamus & Pituitary hormones
Thyroid hormones
Parathyroid hormones
Pancreatic hormones
Adrenal hormones
Gonadal hormones

Paper - IV - General Physiology, Nutrition and Mineral Metabolism. (MMLTB4)

CO1: Knowledge in Function tests - LFT, RFT, PFT
CO2: Knowledge in Cytogenetics
CO3: Knowledge in techniques in genetics

M.Sc Medical Laboratory Technology Page 21 of 46

Digestion and absorption of carbohydrates, lipids, proteins. Absorption of minerals and electrolytes.
Respiration: Oxygen transport, oxygen dissociation curves, Carbon dioxide transport, factors affecting oxygen transport and carbon dioxide transport, oxygen toxicity, free radical formation, anti oxidants.
Blood clotting: Chemistry of blood coagulation and coagulation disorders.
Muscle contraction: Muscle proteins, Muscle energy metabolism, Chemistry of muscle contraction.
Detoxification: Mechanisms of detoxification, oxidation, reduction, hydrolysis, conjugation, detoxification of drugs.
Nutrition: Caloric values of foods, BMR, respiratory quotient, energy requirements, role of carbohydrates, lipids, proteins and amino acids in diet, nitrogen balance, protein energy malnutrition, glycemic index, diet in pregnancy and lactation.
Anemia
Mineral metabolism: Metabolism of calcium, phosphorus, magnesium, sodium potassium, chloride, sulphur, iron, copper, iodine, manganese, zinc, molybdenum, cobalt, nickel, chromium, fluorine, selenium

PART II (Second year)

Paper - V Molecular Biology and Immunology (MMLTB5)

CO1: Knowledge in practical Biochemistry- routine blood chemistry
CO2: Knowledge in analysis of body fluids
CO3: Knowledge in special tests-ELISA
CO4: Knowledge in Chemiluminensce techniques
CO5: Knowledge in immunoflurimetry, biosensors

DNA replication, DNA Polymerase , Cell cycle, DNA repair.
Transcription, inhibition of transcription, genetic code, post transcriptional processing, reverse transcriptase.
Protein biosynthesis, post translational processing, inhibitors of protein synthesis.
Molecular genetics and gene expression, principles of breeding, autosomal, recessive, x-linked recessive, population genetics, gene location on chromosomes, mutations, recombination, mutagens, repression, operon, gene amplification, gene switching, transposition of genes, somatic recombination, enhancer, viruses.
Recombinant DNA technology.
Restriction endonuclease, DNA ligase, vectors, chimeric molecules, cloning, gene library, cloning strategies, insitu hybridization, blot techniques and applications, RFLP, Gene Therapy, Transgenesis, DNA finger printing, DNA sequencing, PCR,
DNA probes, hybridoma technology.
Pre-natal diagnosis of genetic disorders.
Immunology: Principles of immunology, antigen, antibodies and their reactions. Immunoglobulins, MHC, Complement system, Interleukins , Interferons and Cytokines. Cellular

M.Sc Medical Laboratory Technology Page 22 of 46

immunity, immune responses and cells involved , autoimmunity, immuno deficiency diseases.
Immunological Techniques, MIF, TRC, ELISA, Immuno electrophoresis, double diffusion technique , immunofixation, Immunoassay of enzymes, Nephelometric immunoassay, Chemiluminesence immunoassay western blot , Immunofluorescence and Radio immunoassay.
Preparation, assessment and storage of antisera (polyclonal and monoclonal). Methods of assessing analytical sensitivity, specificity and standardization.

PAPER- VI- Diagnostic Biochemistry, Recent advances in clinical chemistry and Biostatistics (MMLTB6)

CO1: Knowledge in biostatistics
CO2: Knowledge in xenobiotics
CO3: Dissertation

Liver diseases and diagnostic tests for liver diseases.
Pathophysiology of diabetes mellitus and related disorders, diagnostic tests for DM
Renal Diseases, tests for diagnosis of renal diseases
Pancreatic Function test
Intestinal function test
Gastric function test
Thyroid function test
Cardiac function test
Feto-Placental function test
Acid-base balance and diagnostic test for acid-base disorders
Diseases of CNS
Renal and pancreatic calculi.
Acute phase proteins:- Diagnosis and significance of C-reactive proteins, alpha feto proteins,
alpha1- anti trypsin,alpha2-macroglobulin, haptoglobulin etc.
Pathophysiology of Cancer, Oncogens, Tumor suppressor genes, Apoptosis. Tumor markers-their biochemical and pathological significance , use in management of benign and malignant tumors. Anti cancer drugs
Biochemistry of AIDS, Laboratory analysis, anti HIV drugs, prevention
Biochemistry of ageing, Alzheimer‟s disease, Prions, Beta amyloid
Toxicology Analysis – Action, detection and quantification of common drugs in therapy and toxic agents. Digoxin, lithium, salicylates, paracetamol, barbiturates, alcohol, morphine derivatives, amphetamines, lead, iron, mercury, carbon monoxide, organophosphates, carbamates and cyanide.
Laboratory Organization, Laboratory Management and Quality management system ISO 9000 system.
Chemicals, reagents and apparatus- their selection, sources of supply and techniques for assessing the quality
Analytical Systems
Electro Chemistry

M.Sc Medical Laboratory Technology Page 23 of 46

Mass Spectrometry
Automatic Clinical Chemistry Analyzers
Point Of Care Test (POCT)
Biostatistics
Reference Intervals And Clinical Decision Limits
Evaluation of methods
Interference in Chemical Analysis
Quality Control in Clinical Chemistry
Quality control serum preparation.

ELECTIVE COURSE AND COURSE OUTCOME

MMLTB40 - Soft Skills

CO1: Attitude to continue lifelong learning.

CO2: Knowledge of gender issues and the attitude to handle such issues.

CO3: Knowledge of environmental issues and the attitude to work towards a sustainable future.

CO4: Competency to take decisions applying ethical values and knowledge of proper etiquette.

CO5: Competency to conduct research.

CO6: Communication skills including teaching skills.

Books Recommended:

1. Biochemistry by Geoffrey L Zubay, Fourth Edition, 1998
2. Fundamentals of Biochemistry by Donald Voet, Judith Voet and Pratt, second edition, 1995
3. Biochemistry – LubertStryer
4. Harper‟s Biochemistry by Murray etal. Appleton and Lange Publishers, 27h edition, 2006
5. Principles of Biochemistry by Lehninger, Nelson and Cox, fourth edition, W H Freman And Company, New York, USA, 2005
6. Textbook of Biochemistry by West and Todd, Fourth Edition, 1966
7. Text book of clinical chemistry - Teitz
8. Varley‟s Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition
9. Practical Biochemistry – Wilson & Walker
10. Clinical chemistry – Marshal
11. Clinical Biochemistry Principle and Practice – Praful B Godkar
12. Lecture notes on Clinical chemistry – L.G.Whitby
13. Clinical Chemistry – Kaplan
14. Clinical chemistry in diagnosis and treatment – Philip D Mayne
15. Clinical Chemistry – Michael L Bishop
16. NMS Biochemistry

M.Sc Medical Laboratory Technology Page 24 of 46

17. Immunology: Janis Kuby fourth edition, W H Freeman Company, USA (2000)
18. Essential Immunology: Ivan Roitt (Blackwell Science Publishers, UK, 1997)
19. A Hand Book of Practical Immunology:GP Talwar (Vikas Publishing House, 1983)
20. Principles of Statistics.

PRACTICAL - FIRST YEAR

PAPER- I

Laboratory safety: Fire, chemical, radiation, handling of biological specimens, waste disposal regulations, workplace hazardous.
Specimen collection, identification, transport, delivery and preservation. Patient preparation for tests.
Anticoagulants and preservatives
Regulations and precautions regarding transport of biological specimens
Preparation of high quality water
pH determination
Preparation of buffers and determination of pH
Measurement of radioactivity
Practical related to solvent extraction, Partition coefficient, Dialysis, Concentration, desalting and Ultracentrifugation.
Calibration of equipment and laboratory wares.
Familiarization and usage of Colorimetry, specterophotometry, fluorimetry, flame photometry, atomicabsorption spectroscopy, nephelometry, osmometry, chemiluminesence, ion selective electrodes, flowcytometry.
Chromatography : - Paper, Thin layer, Gel filtration, Ion exchange, HPLC, GLC, Separation of various sugars, amino acids, lipids, drugs toxins etc. Urine aminogram.
Electrophoresis :- Paper, Agarose gel, Cellulose acetate, PAGE, SDS-PAGE. Separation of serum proteins, lipoproteins, haemoglobin, globin chain and isoenzymes
Tissue homogenization and cell disruption
Cell fractionation methods
Extraction of glycogen and its estimation
Extraction of protein and its estimation
Extraction of lipids and estimation of total lipids, glycolipid, phospholipids and cholesterol.
Determination of saponification number and iodine number from oils
Estimation of lacticacid and pyruvic acid
Qualitative analysis of carbohydrate
Detection of unknown sugars
Qualitative analysis of proteins
Isolation of DNA and RNA
Estimation of DNA and RNA
Agarose gel electrophoresis of DNA

PAPER- II

Study of factors influencing enzyme reaction .
Type of inhibition shown by various inhibitors

M.Sc Medical Laboratory Technology Page 25 of 46

Determination of Km and Vmax of enzyme.
Determination of activity of clinically important enzymes – Alkaline phosphatase, Acid phosphatase, AST, ALT, Amylase, Lipase, LDH, CK, G^PD, Pyruvate kinase, Aldolase, 51- Nucleotidase, Leucine amino peptidase, Gamma glutamyltrans peptidase, Choline esterase, Enolase, Isocitrate dehydrogenase, Catalase, various isoenzymes etc. Estimation and standardization of Glucose, Urea, Cholesterol, Triglycerides, Phopholipids, Total lipid, Uric acid, Creatine , Creatinine, Ammonia, Ketone bodies, Glycosylated haemoglobin, Bilirubin,, Plasma haemoglobin , Myoglobin
Investigations of Alkaptoneuria, Cystinuria, Pentosuria, Glycogen storage diseases, Galactosemia.
Estimation of porphyrins and porphobilinogen in urine.
Urine qualitative and quantitative analysis.
Biochemical analysis of CSF, Amniotic fluid, Peritoneal fluid, Pericardial fluid, Pleural fluid, Synovial fluid, Semen etc.

PAPER- III

Estimation of vitamin A,C,E from serum and metabolites of vitamins in urine.
Analysis of various hormones related to biological functions and disorders of Hypothalamus, Pituitary, Thyroid, Parathyroid, Pancreatic, Adrenal, Gonads etc.
Estimation of hormone metabolites in urine – 17- ketosteroid, 17- ketogenicsteroid,VMA, 5- HIAA, Urinary estriol etc.

PAPER- IV

Bleeding disorders – PT, APTT, TT, Fibrinogen
Estimation of Calcium , Phosphorus, Magnesium, Manganese, Sodium , Potassium, Chloride, Iron , Copper, Iodine, Zinc, Protein bound iodine

PRACTICAL - SECOND YEAR

PAPER- V

Isolation of plasmid DNA
Identification of DNA by agarose gel electrophoresis.
Restriction enzyme digestion of Plasmid DNA.
Separation of DNA fragments after restriction enzyme digestion by agarose gel electrophoresis.
Polymerase chain reaction and confirm the amplification by agarose gel electrophoresis.
Application of PCR in diagnosis of diseases.
Blotting of DNA and RNA and the detection of blot.
Agglutination reaction, Precipitation reaction, Immunodiffusion, Double diffusion technique, Immuno electrophoresis, Immunofixation, Migration inhibition factor, ELISA, Nephelometric immunoassays, Chemiluminesence immunoassays, Immunofluorescence,
Western blotting and identification of blot by ELISA technique.
Preparation of antisera and its standardization.

M.Sc Medical Laboratory Technology Page 26 of 46

PAPER- VI

Diagnostic tests – Diabetes mellitus, Liver function, Renal function, Cardiac function, Thyroid function, Feto-placental function, pancreatic function, Intestinal function, Gastric function, Acid base disorders etc.
Detection of Tumor markers.
Lab diagnosis of HIV
Detection and estimation of acute phase proteins.
Analysis of renal and pancreatic calculi
Analysis of common drugs in therapy and detection of Toxins
Collection and tabulation of data
Graphical representation of data
Correlation and regression analysis
Student „t" test
Chi-square test
Analysis of variance
Quality control charts, calculation of various values and it interpretations.
Preparation of QC sample.

Books Recommended for Practical:

1. Text book of clinical chemistry - Teitz
2. Varley"s Practical Clinical Biochemistry by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition
3. Practical Biochemistry – Wilson & Walker
4 . Clinical Biochemistry Principle and Practice – Praful B Godkar
5. Essential Immunology : Ivan Roitt (Blackwell Science Publishers, UK, 1997)
6. A Hand Book of Practical Immunology : GP Talwar (Vikas Publishing House, 1983)
7. Principles of Statistics.

Paper .VII – Dissertation.

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M.Sc Medical Laboratory Technology Page 27 of 46

M.Sc MLT (MICROBIOLOGY)

Paper	Sub-ject	Theor y	Practical hours	Clinical Laborato-ry Prac-tice hours	Total hours
First year					
Paper-I	General Microbiology	100 hrs	600 hrs	1250 hrs	2250 hrs
Paper-II	Systematic & Diagnostic Bacteriology	100 hrs			
Paper -III	Medical Parasitology	100 hrs			
	and Mycology				
Paper- IV	Immunology	100 hrs			
Second year					
Paper -V	Medical Virology	100 hrs	300 hrs	1150 hrs	1650 hrs
Paper -VI	Applied Medical Microbiology and Recent Advances	100 hrs			
	Dissertation				600 hrs
Total	First and second year including Dissertation				4500 hrs

PART I (First year)

1. CO1: To learn the preparation of various culture media
2. CO2: To understand the various cultivation techniques used in microbiology laboratory
3. CO3: should be able to use automated cultivation and identification systems in the microbiology laboratory
4. CO4: should be able to illustrate the role of experimental animals in laboratory diagnosis.

Paper I - General Microbiology. (MMLTMI1)

Introduction to Microbiology

History & scope of microbiology, safety methods in microbiology Laboratory, first aid in microbiology laboratory, universal safety precautions, safety cabinets, common glassware for microbiology and its cleaning and sterilization, disposal of waste materials in microbiology. Sterilization and disinfection

Physical methods

Heat -Autoclaves, hot air oven

Filtration

Radiation

Chemical methods

M.Sc Medical Laboratory Technology Page 28 of 46

Disinfectants, Antiseptics, Testing of disinfectants.
Disinfection of thermo labile equipments
Sporicidal agents
Mycobacterial disinfection
Quality control in sterilization.

Microscope

Principle, methods of safe working, different parts, preparation of smears for examination, applications of following microscopes –

Bright field, dark ground, phase contrast, differential interference contrast, fluorescent, electron (scanning, transmission (STEM), polarizing, tunneling and confocal.

Micrometry.

Bacterial morphology

Ultra structure of bacterial cell, cell wall, capsule, flagella, fimbria, bacterial spores, cytoplasmic inclusions.

Staining methods for bacteria

Principles, preparation of stains and reagents preparation of smears, modification of following staining methods

Simple staining, differential staining (Gram staining, AFB staining), Negative staining, Fluorochrome staining, Staining of Volutin granules, Staining of spirochetes, spore staining, capsular staining, flagellar staining.

General Bacteriology

Classification of Medically important Bacteria

Bacterial Metabolism, Bacterial growth, Growth Requirements, Growth Curve. Culture Media

Classification of culture Media, Preparation of Culture Media, Quality Control of Culture Media.

Inoculation, Incubation & purification methods in bacteriology. Quantitation of bacterial growth

Preservation of bacteria.

Biochemical tests for Identification

Principle, Media & Reagents, Method, Interpretation & Quality Control of Biochemical tests.

Tests for metabolism of carbohydrates.

Tests for metabolism of proteins and amino acids.

Tests for enzymes.

Tests for metabolism of fats.

Rapid identification systems.

Bacterial genetics

Phenotypic and genotypic variations, Regulation and expression of gene activity, Genetic transfer in bacteria.

Practical

Preparation of bacterial smear and staining.

Preparation of media, cultivation of bacteria, Biochemical tests for identification bacteria.

Paper II Systematic and Diagnostic Bacteriology (MMLTMI2)

CO1: to develop detailed knowledge regarding medically important, pathogenic bacteria

M.Sc Medical Laboratory Technology Page 29 of 46

CO2: to know the collection, preservation, transport and processing of clinical specimens for the diagnosis of bacterial infections
CO3: to understand the different methods & interpretation of antibiotic sensitivity tests.
CO4: should know in detail the serodiagnosis of selected bacterial infections

Systemic Bacteriology
Isolation and identification of bacteria.
Gram positive cocci of medical importance including Staphylococcus, Micrococcus, Streptococcus, Enterococcus,
Mycobacteria: general characters and classification.
Gram negative cocci of medical importance including Neisseria, Branhamella, Moraxella, Veillonella
Gram positive bacilli of medical importance including Lactobacillus, coryneform organisms, Gardnerella, Bacillus, Actinomyces, Nocardia, Actinobacillus and other Actinomycetales, Propionibacterium, Bifidobacterium, Eubacterium, Erysipelothrix, Listeria, Clostridium and other spore-bearing anaerobic bacilli.
Gram negative bacilli of medical importance including Enterobacteriaceae,Vibrio, Aeromonas, Plesiomonas, Haemophilus, Bordetella, Brucella, Pasteurella, Francisella, Legionella, Pseudomonas, Burkholderia, Chromobacterium, Flavobacterium, Acinetobacter, Achromobacter, Cardiobacterium and other non-fermenters, Bacteroides, Fusobacterium, Prevotella, Porphyromonas, Leptotrichia, Mobiluncus and other anaerobic Gram negative bacilli, Helicobacter, Campylobacter and Spirillum, Spirochaetes, Mycoplasmas and chlamydiae, Rickettsiae including Bartonella, Coxiella, etc.
Knowledge of the above family/ genus/ species should include definition, historical perspectives, classification, morphology, cultural characteristics, metabolism, and antigenic structure, laboratory isolation and identification, tests for virulence and pathogenicity, susceptibility.

Practical

Study of morphological, cultural and biochemical characters of common bacterial pathogens.
Diagnostic Bacteriology
Epidemiology of bacterial infections, Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections

- Bacterial infections of respiratory tract.
- Bacterial infections of gastro intestinal tract and food poisoning.
- Bacterial urinary tract infections.
- Bacterial infections of genital tract and reproductive organs.
- Bacterial infections of central nervous system.
- Skin and soft tissue infections.
- Bone and joint infections
- Eye ear and sinus infections
- Cardiovascular infections
- Tissue samples for culture
- Anaerobic infections

M.Sc Medical Laboratory Technology Page 30 of 46

Zoonotic infections.
Infections associated with immunodeficiency and immune suppression
Pyrexia of unknown origin.

Bacterial immuno serology

Enteric fever
Streptococal infections
Syphilis
Rickettsial infections
B rucellosis
Primary atypical pneumonia
New rapid serological diagnostic methods for bacterial infections.

Antibiotics in clinical laboratory
Antibiotics and mechanism of action
MIC&MBC
Invitro susceptibility tests-Different methods
Rapid methods of antibiotic susceptibility tests
Antibiotic resistance mechanisms
Detection of methicillin resistant staphylo coci

Practical

Isolation, Characterization and identification of pathogens from various clinical specimens.
Study of antibiotic sensitivity of common pathogens

Common serological tests for the diagnosis of bacterial infections.

Paper –III Medical Parasitology & Mycology (MMLTMI3)

CO1: should be able to describe the life cycle of medically important parasites and define the organs commonly involved in the infection
CO2: should be able to demonstrate practical skills in fundamental parasitological techniques
CO3: should be able to explain the methods of parasite control, e.g. chemotherapy, molluscicides, general sanitation plus describing the advantages and disadvantages of each method
CO4: student should be able to demonstrate knowledge and understanding of biology of vectors and intermediate hosts
CO5: should be able to explain different methods to control insects and spread of infection.

M.Sc Medical Laboratory Technology Page 31 of 46

General parasitology
Classification of medically important parasites, epidemiology of parasitic infections, immunology of human parasitic infections.

Diagnostic parasitology

Systemic study of following parasites (Geographical distribution, habitat, morphology and life cycle, risk of infection, pathogenesis, laboratory diagnosis prophylaxis and serological diagnosis)

Protozoa – Intestinal amoeba, free living pathologic amoeba, Giardia, Trichomonas,
Balantidium, Isospora, Cryptosporidium, Microspora.
Malaria, Leishmania, Trypanasoma, Toxoplasma, Babesia.

Helminthes –
Cestodes – Taenia, Echinococus, Diphylobothrium.
Trematodes- Schistosoma, Fasciola, Fasciolepsis, Paragonimus.
Nematodes- Ascaris, Hookworm, Trichuris, Enterobius, Strongyloides, Filaria, Trichinella, Toxocara, Dracunculus

Practical

Examination of stool for parasites.
Examination of blood & bone marrow for parasites.
Examination of other body fluids & biopsy specimens for parasites. Culture techniques for parasites.
Serological diagnostic methods in parasitology.

Mycology

General Mycology – Fungus – Classification
Fungal Structure & Morphology, Immunity to Fungal Infections.

Culture Media in Mycology , Stains in Mycology.

Diagnostic Mycology

Epidemiology, Pathogenesis, Laboratory Diagnosis of Fungal Infections.
Specimen collection, preservation, Transportation & Identification of Mycological Agent. Anti fungal agent, invitro tests.
Serological tests for mycotic infections.

Use of lab animals in Mycology.

Superficial Mycosis – Pityriasis Vessicolor, white piedra, black piedra, tinea nigra, Malassezia species, dermatophytes.
Subcutaneous Mycosis – Mycetoma Sporotrichosis, Chromoblastomycosis, Phaeohyphomicosis, Rhinosporidiosis, Lobomicosis.
Systemic Mycosis- Histoplasmosis, Blastomicosis, Coccididiomicosis, Para Coccididiomicosis
Opportunistic Mycosis – Candidiasis, Aspergillosis, Zygomicosis, Penicillin marneffei, pneumocystis Carinii.

M.Sc Medical Laboratory Technology Page 32 of 46

Miscellaneous Mycosis- Otomycosis, fungal infections in eyes, Mycotoxins, Allergic Fungal diseases.

Practicals

Media & Stains preparation for Mycology, Diagnostic Methods in Mycotic Infections,

Identification test in Mycology, Serological tests in Mycology.

Paper-IV Immunology(MMLTMI4)

CO1: To differentiate between innate and adaptive immunity, and explain the main defences lines as well as biological barrier to the infections

CO2: Explain the main defences lines as well as biological barrier to the infections

CO3: Employ antigen –antibody interaction to conduct different immunological and serological tests in the laboratory

History of immunology, innate and acquired immunity, immune system, antigens,immunoglobulin, Monoclonal antibodies, MHC, complement system, interleukins an interferons, immune responses and cells involved, immunity and infection, tumor immunology, hypersensitivity reactions, autoimmunity and autoimmune diseases, immuno deficiency, transplantation and rejection, immunomodulation including vaccines with recent developments.

Clinical laboratory methods for detection of antigens and antibodies-
Precipitation reactions-immunodiffution, immunoelectrophoresis,
Agglutination, complement fixation, neutralization.

Binder ligand assay- ELISA, RIA, Immunofluoresence, immuno blotting.

Clinical laboratory methods for-

- Detection of cellular immune function
- Delayed hypersensitivity skin tests
- Assay for lymphocytes
- Flow cytometry and cell sorting.

PART II (Second year)

CO1: should know the various laboratory detection methods of viral diseases

CO2: should know the various preventive measures of viral diseases

CO3: should know the various treatment of viral diseases

Paper V - Medical Virology (MMLTMI5)

General virology- General characteristics and classification of viruses, Morphology and structure of viruses, Bacteriophage, propagation and identification of viruses

-Cell culture, embryonated eggs, animal inoculation,

-Viral replication and virus-host cell interactions

M.Sc Medical Laboratory Technology Page 33 of 46

-Safety in the virology laboratory.

Systematic Virology- Systematic study of following viruses

Parvo viruses, Adeno viruses, Papova virus, Herpes virus, Pox virus, orthomyxovirus, paramyxovirus , Rubella virus, Arbovirus, Rhabdo virus, Hepatits viruses, Retro viruses, Human enteric viruses, Oncogenic viruses, Prions of humans.

Diagnostic virology-

Laboratory diagnosis of viral infections.

Collection, Preservation, transportation, Processing, and reporting of various clinical specimens for viral infections.

Pathogenesis of viral infections

Immune response to viral infections

Epidemiology of viral infections

Antiviral agents

Viral infections in immunocompromised patients.

Emergence and re-emergence of viral infections.

Practical

Diagnostic tests in virology, Animal-cell cultures, Media, Sterilization, Demonstration of cell lines, CPE, embryonated egg inoculation, immuno fluorescent techniques, Viral neutralization tests, Viral haemagglutination tests and haemagglutination inhibition tests, serological tests for viral infections, Western blot technique.
(Students should visit and observe all techniques in virology in a reputed institute)

Paper VI Applied Medical Microbiology and Recent advances (MMLTMI6)

CO1: should be able to differentiate between common laboratory contaminates and pathogens.
CO2: should learn the various laboratory detection methods and preventive measures of fungal infections.
CO3: should learn to follow standard operating procedures in the microbiology laboratory.

Nosocomial infections

Epidemiological aspects of control infections and diseases

Typing methods in Bacteriology

Hospital acquired infections

Surgical and trauma related infections

Microbial bio – film -prevention, control and removal

Role of microbiology lab for infection control in hospital

Emerging infectious diseases

Public Health Microbiology

Microbiology of air

Bacteriology of water and water born infections

Microbiology of milk and milk products

M.Sc Medical Laboratory Technology Page 34 of 46

Milk born infections
Bacteriology of food and food born diseases
Vaccines for infectious diseases
Molecular diagnostic methods in microbiology
Automation in diagnostic microbiology
Microbiology Laboratory Physical design, Management and organization
Quality in the clinical Microbiology Laboratory
Genetically modified microorganisms

Molecular Diagnostic methods

Molecular diagnostic techniques relevant to medical microbiology.
PCR and its modifications including nested PCR, Multiplex PCR.
Special emphasis to Real-time PCR.
Principles of different hybridization techniques
Principles of recombinant DNA technology

Care and management of laboratory animals

Handling feeding, breeding of common laboratory animals
Bleeding of lab animals
Killing of animal and disposal of carcasses

MMLTMI40 - Soft Skills (Elective Course)

CO1: Attitude to continue lifelong learning.

CO2: Knowledge of gender issues and the attitude to handle such issues.

CO3: Knowledge of environmental issues and the attitude to work towards a sustainable future.

CO4: Competency to take decisions applying ethical values and knowledge of proper etiquette.

CO5: Competency to conduct research.

CO6: Communication skills including teaching skills.

Practical

Animal inoculation and bleeding.
Animal house management
Microbial analysis of water
Microbial analysis of air
Microbial analysis of milk
Microbial analysis of food

Reference books

1. Topley & Wilsons – Microbiology & Microbial Infections – 9th Edition
   Leslie Collier, Albert Balows, Max Sussman – Volume I, II, III, IV, V
2. Mandell, Douglas & Bennetts
   Principle & Practice of Infectious Diseases – Volume I, II – IVth Edn

M.Sc Medical Laboratory Technology Page 35 of 46

3. Colour atlas of & text book of Diagnosis Microbiology – IVth Edn Felmer W. Koneman
4. Bailey & Scott‟s Diagnostic Microbiology – 12th Edn
5. Jawetz Melnick & Adelberg‟s Medical Microbiology
6. Medical Microbiology – Minna Plafair Roitt

Paper VII Dissertation

M.Sc MLT (PATHOLOGY)

Paper	Subject	Theory Hours	Practical Hours	Clinical Laboratory Practice Hours	Total Hrs
FIRST Year					
Paper-I	Haematology	100 hrs	600 hrs	1250 hrs	2250 hrs
Paper-II	Histopathology	100 hrs			
Paper-III	Clinical Patholgy & Cytogenetics	100 hrs			
Paper-IV	Cytology	100 hrs			
SECOND year					
Paper-V	Blood banking & Immunopathology	100 hrs	300 hrs	1150 hrs	1650 hrs
Paper-VI	Laboratory Organization, QC, and Recent Advances in Pathology	100 hrs			
	Dissertation				600 hrs
Total	First and second year including Dissertation				4500 hrs

PART- I (First year)

Paper- I HEMATOLOGY (Theory and Practicals) (MMLTPA1)

1. CO1: Should have a thorough knowledge about the causes, classification and Algorithmic approach for different types of anemia and the interpretation of each test.
2. CO2: Thorough understanding about the normal Hemostatic Mechanism .
3. CO3: Mechanisms underlying Primary , Secondary haemostasis and fibrinolysis.
4. CO4: Should be expertise in performing Complete work-up for the Bleeding disorders and know how to Interpret them .
5. CO5: Should be expertise in performing Complete work-up for Coagulation disorders and to interpret them .
6. CO6: Primary evaluation of the peripheral smear & their further work up including Special Stains .

M.Sc Medical Laboratory Technology Page 36 of 46

7. CO7: Basic knowledge about Molecular techniques that aid in the diagnosis of haematological malignancies.

Haemopoiesis
Anaemia and other disorders of Erythropoiesis
Disorders of Leucopoiesis
Haemostasis & its investigations
Investigations of Thrombotic tendency
Laboratory control of Anticoagulant, Thrombotic and platelet therapy
Collection and handling of Blood
All Routine and special Haematological Investigations
Blood and Bone Marrow preparations
Leucoproliferative disorders with special references to Leukaemias
Automation in Haemtology
Cytochemistry of Leukaemic cells
Amniocentesis
Bone marrow transplantation
Application of different Microscopes
Preparations of various Reagents and Stains used in Haematology
Immunophenotyping
Flowcytometry
Molecular techniques in Haematology

Paper-II – HISTOPATHOLOGY (MMLTPA2)

1. "CO1: To know about tissue processing for different microscopic techniques and
2. it's troubleshooting ."
3. CO2: Cut a section from given block and do H & E stain on it .
4. CO3: Demonstrate all special stains in Histopathology .
5. CO4: To know about museum mounting technique & IHC .
6. "CO5: Should have thorough knowledge about IF , enzyme histochemistry and
7. autopsy techniques ."
8. CO6: Primary evaluation of the peripheral smear & their further work up including Special Stains .
9. CO7: Should have a thorough knowledge about molecular techniques

Theory and Practicals)
Organisation of Histology Laboratory
Histological equipments
Reception and recording of tissue specimen
Tissue processing and Microtomy including frozen
Theory of staining
Preparation and quality control of all routine and special stains used in Histopathology
All staining techniques and their interpretation
Immunohistochemistry
Molecular markers of malignant neoplasms
Molecular techniques

M.Sc Medical Laboratory Technology Page 37 of 46

Immunofluorescent techniques
Enzyme histochemistry
Museum techniques
Autopsy Techniques
Automation in Histological Techniques

Paper- III - CLINICAL PATHOLOGY AND CYTOGENETICS (MMLTPA3)

1. "CO1: Complete urine and other body fluid analysis and should be able to
2. intrepret the results."
3. CO2: Tests that done in clinical pathology and its clinical significance
4. CO3: QC Measures in clinical pathology and trouble shooting.
5. CO4: Automation in semen,stool,urine,body fluid analysis.
6. CO5: should be able to perform routine and special tests that comes under clinical pathology with a thorough knowledge about their clinical significance.
7. CO6: Basic concepts of genetics .
8. CO7: Role of genetics in prevention & management of various disease.
9. CO8: Structure of chromosome & it's abnormalities.
10. CO9: Karyotyping & advanced techniques like FISH & SKY.
11. CO10: Should be able to perform Sex chromatin determination.
12. CO11: Should have a basic idea about modern genetic concepts like gene mapping,gene libraries,DNA fingerprinting etc..

(Theory and Practicals)
Examination of Urine - Routine and Special tests
Examination of Stool - Routine and Special tests
Examination of Sputum - Routine and Special tests
Semen examination - Routine and Special tests
Examination of CSF - Routine and Special tests
Examination of various body fluids-Pleural Fluid, Pericardial Fluid, Synovial Fluid, Ascetic Fluid
Various methods of detecting HCG levels
Structure and molecular organization of Chromosomes
Identification of human chromosomes
Karyotyping
- Direct chromosome preparation of Bone Marrow cells
- Culture techniques

Banding techniques
Sex Chromatin bodies
Autoradiography of human chromosomes
Chromosome Identification by image analysis and Quantitative cytochemistry
Clinical Manifestations of chromosome disorders

Paper-IV – CYTOLOGY (MMLTPA4)

1. CO1: Processing of all samples in Cytology .
2. CO2: Cytology of FGT,RT,UT,GIT,CSF ,miscellaneous fluids and its processing .
3. CO3: To demonstrate PAP,MGG & special stains in cytology.

M.Sc Medical Laboratory Technology Page 38 of 46

4. CO4: Screening of the cervical smear.
5. CO5: QC measures done in Cytology lab.
6. CO6: Automation in Cytology .
7. CO7: Thorough knowledge about FNAC , Flow cytometry & immunocytochemistry.

(Theory and Practical)
Morphology and Physiology of cell
Cytology of
- Female genital Tract
- Urinary Tract
- Gastrointestinal Tract
- Respiratory Tract
- Effusions
- Miscellaneous Fluids

Collection, Preservation, Fixation and Processing of various Cytological Specimen Preparation and Quality control of various stains and reagents used in cytology
All routine and special Staining techniques in cytology
FNAC
Immunocytochemistry
Flowcytometry
Automation in Cytology

PART - II (Second year)

Paper- V - BLOOD BANKING & IMMUNOPATHOLOGY (Theory and Practical)
(MMLTPA5)

1.
2. CO1: Clinical & laboratory aspects of transfusion medicine.
3. CO2: How to provide safe and effective blood & blood products .
4. CO3: Preservation, processing storage and proper component therapy.
5. CO4: Importance of blood donation & the tests related to it's screening like NAT
6. CO5: Automation in & Recent advances in Blood Bank .
7. CO6: QC of blood products.
8. CO7: Should have an ability to perform and interpret all special techniques in transfusion medicine.
9. CO8: Skill in resolving discrepancies while performing the tests.
10. CO9: Basic concepts of Immunology .
11. CO10: Molecular and genetic techniques for clinical analysis of the immune systems.
12. CO11: To know about different techniques in serum protein & cell separation.
13. CO12: Role of Immunology in diagnosis of various diseases.
14. CO13: Illustrate the adverse effect of immune system including hypersensitivity and Autoimmunity.
15. CO14: Interpret immunization and its role in protection against diseases.
16. CO15: should have an idea about experimental animal methods.

Blood banking

M.Sc Medical Laboratory Technology Page 39 of 46

Basic principles of Immunohaemeatology
ABO Blood group systems
Rh Blood group systems
Other blood group systems
All materials and reagents used for different investigations in blood bank
Blood grouping techniques
Antibody screening and Identification
Compatibility testing
Blood collection and processing
Preservation and storage of blood
Blood component preparation and therapy
Screening tests
Transfusion reactions
HDN
Quality assurance in Transfusion Service
Special investigations in Transfusion technology

Immunopathology

History of Immunology and Immunopathology
Review of Basic Immunology
Transplantation Immunology
Immune response to infectious diseases
Vaccines
Immunodeficiencies- B cell, T cell, Combined, Phagocytic & Compliment
Cancer and the immune system
Hypersensitivity
Autoimmune diseases
Clinical Laboratory methods for the detection of antigens and Antibodies
Clinical Laboratory methods for the detection of cellular immunity
Histocompatibility testing
Molecular genetic techniques for clinical analysis of the immune systems
Experimental animal methods
Raising antibodies in laboratory animals
Recombinant DNA Technology
Gene transfer to Mammalian cells
Separation serum protein by different electrophoresis
Separation of different cells in the blood

PAPER- VI - LABORATORY ORGANIZATION, QUALITY CONTROL AND RECENT ADVANCES IN PATHOLOGY(MMLTPA6)

1. **C**O1: Should be able to organize clinical laboratory at different levels .
2. CO2: Should have thorough knowledge about the Management of Inventory.
3. CO3: Could effectively manage the Quality control activities of Histopathology,Haematology& cytology lab .
4. CO4: Interpretation of Levy Jenning's chart , Root Cause Analysis and suggesting corrective and preventive Action .

M.Sc Medical Laboratory Technology Page 40 of 46

5. CO5: Should be able to involve actively in the step for accreditation process for National and International Accreditations.
6. CO6: Thorough knowledge about the statistics involved in laboratory.
7.

(Theory and Practical)
Different levels of laboratories
Basic requirements and functions of a laboratory
Purchasing of equipments and chemicals
Open and closed system analyzers
National and international accreditation of laboratories
Laboratory safety
Quality control, External and internal quality controls, quality control materials, filing of QC charts
Principles of Instrumentation
Automation in Hematology, Cell counters, coagulation analyzers, ESR by automation, Blood collection and delivery to different laboratories in a hospital
Automation in Histopathology – New generation microtomes, tissue processing, paraffin, Embedding, Station, tissue -tek systems, image analysis, stainers and cover slippers. Use of microwave oven
Automation and recent advances in different disciplines of pathology
New generation equipments used in blood banks
Laboratory statistics
Clinical Laboratory Informatics
All aspects Laboratory management including financial management

MMLTPA40 - Soft Skills (Elective Course)

CO1: Attitude to continue lifelong learning.

CO2: Knowledge of gender issues and the attitude to handle such issues.

CO3: Knowledge of environmental issues and the attitude to work towards a sustainable future.

CO4: Competency to take decisions applying ethical values and knowledge of proper etiquette.

CO5: Competency to conduct research.

CO6: Communication skills including teaching skills.

Books Recommended:

1. Theory and practice of histological Techniques John.D.Bancroft
2. Hand book of histopathological Techniques. CFA Culling
3. Practical haematology. Davie & Lewis
4. Wintrobes Practical haematology
5. Lynch‟s Medical Laboratory Technology

M.Sc Medical Laboratory Technology Page 41 of 46

6. Haematology Charles E David
7. Diagnostic Cytology Koss. Volume I & II
8. de Gruchy‟s Clinical Haematology
9. Atlas of Haematology.
10. Henry‟s Clinical Diagnosis&Management by Laboratory method.
11. Basic Histopathology – Stevens.
12. Practical Cytology – Astarita.
13. Atlas of Haematology – Mc Donald-Paul Anderson.
14. Recent Advances in Haematology – Choudhary.
15. Hand book of Medical Laboratory Technology – Robert H. Carman
16. Compendium of Transfusion Medicine.- Dr.R.N. Makroo
17. Immunology – Kuby.
18. Cytogenetics by Yunis.

M.Sc Medical Laboratory Technology Page 42 of 46

SCHEME of EXAMINATION

M.Sc Medical Laboratory Technology – Biochemistry

Year	*Paper*	*Maximum*	*Minimum*
1st Year (Part I)	Paper-I General Biochemistry & Chemistry of Biomolecules Theory Internal assessment Total	 100 50 150	 50 20 75
	Paper-II Enzymology ,Metabolism and Inborn errors Theory Internal assessment Total	 100 50 150	 50 20 75
	Paper- III Vitamins & Hormones Theory Internal assessment Total	 100 50 150	 50 20 75
	Paper- IV General Physiology, Nutrition &Mineral Metabolism Theory Internal assessment Total	 100 50 150	 50 20 75
	Practical Internal assessment Viva voce Total	300 50 50 400	150 20 200
	TOTAL for PART	**1000**	**500**

2nd Year (Part II)	Paper -V Molecular Biology & Immunology Theory Internal assessment **Total**	 100 50 **150**	 50 20 **75**
	Paper -VI Diagnostic biochemistry, Recent advances in clinical chemistry and Biostatics, Theory Internal assessment **Total**	 100 50 **150**	 50 20 **75**
	Practical Internal assessment Viva voce Total	200 50 50 300	100 20 150
	Dissertation	400	200
	TOTAL for PART II	**1000**	**500**
GRAND TOTAL (first & second year)		**2000**	**1000**

M.Sc Medical Laboratory Technology Page 43 of 46

M.Sc Medical Laboratory Technology - Microbiology

Year	*Paper*	*Maximum Marks*	*Minimum Marks*
1st Year (Part I)	Paper- I General Microbiology Internal Assessment Total	 100 50 150	 50 20 75
	Paper- II Systematic and Diagnostic Bacteriology Internal Assessment Total	 100 50 150	 50 20 75
	Paper III Medical Parasitology and Mycology Internal Assessment Total	 100 50 150	 50 20 75
	Paper- IV Immunology Internal Assessment Total	 100 50 150	 50 20 75
	Practical- Viva voce Internal Assessment Total	300 50 50 400	150 20 200
	Total for PART I	**1000**	**500**
2nd Year (Part II)	Paper- V Medical Virology Internal Assessment Total	 100 50 150	 50 20 75
	Paper- VI Applied Medical Microbiology and Recent Advances Internal Assessment Total	 100 50 150	 50 20 75
	Practical Viva voce Internal Assessment	200 50 50 300	100 20 150
	Dissertation	400	200
	TOTAL for PART II	**1000**	**500**
GRAND TOTAL		**2000**	**1000**

M.Sc Medical Laboratory Technology Page 44 of 46

M.Sc Medical Laboratory Technology – Pathology

Year	*Paper*	*Maximum Marks*	*Minimum Marks*
1st Year (Part I)	Paper- I Haematology Internal Assessment Total	 100 50 150	 50 20 75
	Paper- II Histopathology Internal Assessment Total	 100 50 150	 50 20 75
	Paper- III Clinical Pathology & Cytogenetics Internal Assessment Total	 100 50 150	 50 20 75
	Paper- IV Cytology Internal Assessment Total	 100 50 150	 50 20 75
	Practical Internal Assessment Viva voce Total	300 50 50 400	150 20 200
	Total for PART I	**1000**	**500**
2nd Year (Part II)	Paper -V Blood Banking & Immunopatholgy Internal Assessment Total	 100 50 150	 50 20 75
	Paper -VI Laboratory Organization ,QC, and Recent Advances in Pathology Internal Assessment Total	100 50 150	50 20 75
	Practical Internal Assessment Viva voce Total	200 50 50 300	100 20 150
	Dissertation	400	200
	TOTAL for PART II	1000	500
GRAND TOTAL		**2000**	**1000**

M.Sc Medical Laboratory Technology Page 45 of 46

PATTERN OF QUESTION PAPERS

All the question paper shall be of standard type. Each theory paper will be of 3 hours duration and shall consist of ten questions carry equal mark with a maximum of 100 marks. Theory paper in all subjects will consist of ten questions of 10 marks each or two sub questions in a ten mark main question.

IMPORTANT TELEPHONE NUMBERS

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