

**H.N.B. Garhwal University, Srinagar
(Garhwal) – 246 175, Uttaranchal**

Syllabus & Ordinances

**Post Graduate Courses
(W.e.f. 2003-2004)**

M.Sc. Medical Lab Technology (Pathology)

M.Sc. Medical Lab Technology (Pathology)

In these regulations unless the context otherwise required

- i. “Programme” means 2 year (4 semester) M.Sc. Degree Programme in Medical Lab Technology (Pathology)
- ii. “Courses means a theory or practical subject that is normally studied in a semester, like, Immunology, Bacteriology, Pathology, Biochemistry etc.
- iii. “Faculty” means a faculty of the University like faculty of ART, Faculty of Science, Faculty of Agriculture etc. A Dean Heads each Faculty.
- iv. The University means H.N.B Garhwal University, Srinagar (Garhwal) Uttarakhand.

1. GENERAL

- i. The course of study in each programme shall extend over a period of 2 years (4 semesters). Each year consists of two semesters, namely Autumn (July-Dec) and spring (Jan-May) semesters. Each academic year shall commence with the start of Autumn semester.
- ii. Each semester shall ordinarily be of 90 instructional plus 15 days for examination.

2. MODE OF ADMISSION

- i. Eligibility: The minimum qualification for admission to the master’s courses in Medical Lab Technology shall be:
 - a. B.Sc. in Human biology, Medial Lab Technology, Microbiology, Medical Microbiology, Pathology, Biochemistry or equivalent pass with second division or equivalent grade.
 - b. M.Sc. either in Medical or Animal Science subjects like M.Sc. in Zoology, Biochemistry, Microbiology, Human Physiology, Anatomy, Toxicology or equivalent with 50% in aggregate marks or 45% in case of SC/ST candidates.
- ii. The number of seats for each programme shall be decided by the university.
- iii. The admission to M.Sc. First semesters of each programme will presently be made on merit basis in autumn semester (July-Dec). However, whenever university feels necessary, the admission may be made through written test for which university will issue separate notification.
- iv. The candidate will follow all admission formalities prescribed by the University / Institute / College.
- v. Admission process to M.Sc. Programme shall be completed by office of Dean/Director or Principal of college.
- vi. Reservation of seats is applicable as per the [policy of Govt. of Uttarakhand].

3. ATTENDANCE

- i. Each and every student is required to attend all the lectures, tutorials practical and other prescribed curricular and co-curricular activities, 75% attendance in theory & practical separately is compulsory in each paper.
- ii. The Dean/Director/Principal can grant a relaxation of attendance up to 05% for the students who were absent with prior permission for reasons, acceptable to them. Vice Chancellor can further Condon up to 05% on genuine reasons.
- iii. No students will be allowed to appear in the end of semester examination if he/she does not fulfill the attendance requirements as mentioned in section (i) & (ii) above.

- iv. The attendance shall be counted from the date of admission for the purpose of appearing in the semester examinations.

4. MAXIMUM DURATION

- i. A student failing twice in any semester examinations and also ineligible for the carry over system, shall not be allowed to continue the studies further (governed by Sec. 7.2).
- ii. The maximum time allowed to complete M.Sc. course shall be 5 years. If a student at any stage of his/her course is found unable to complete it within the said time, he/she shall not be allowed to continue the studies further.

5. CURRICULUM

- i. The 2 years curriculum includes lectures, practical, seminars and project in addition to practical training and educational trips/tour
- ii. The students will also take co-curricular and extra curricular activities such as NSS, NCC, Sports etc. as prescribed by the university.

6. SPECIALIZATION

Degree will be awarded in the following categories:

- i. M.Sc. MLT (Pathology with Haematology)
- ii. M.Sc. MLT (Pathology with Clinical Biochemistry)
- iii. M.Sc. MLT (Pathology with Clinical Microbiology)

7. EXAMINATION

- i. The examination will be held in December and May for the first/third and second/fourth semesters, respectively.
- ii. All eligible students must register for examination by specified date as communicated by the university in each semester.
- iii. The minimum pass mark in each theory paper (including internal assessment marks) and in each practical exam shall be 40% separately.
- iv. Each practical shall be conducted jointly by one internal faculty member and an external expert appointed by the University.
- v. The total marks and their distribution for internal assessment, and semester theory and practical are prescribed in syllabi of each course.
- vi. Pass/fail in a particular semester shall be declared only on the basis of the total marks obtained by the candidate in relevant/concerned semester examinations.
- vii. Wherever, there is a provision of seminars/project etc. these will be evaluated internally by a panel of at least 2 faculty members.
- viii. In the final exam of each semester, each theory paper will be of three hours duration.
- ix. The medium of instruction in teaching and examinations will be English.

8.1 PROMOTION RULES

- i. A candidate satisfying all the conditions under examination rules shall be promoted to next semesters.
- ii. A candidate not satisfying the above conditions but failing in not more than two theory papers of semester examination shall be governed by section 7.2.

All other candidates will be required to repeat the semester either as regular candidates after readmission. This facility is however subjected to the time limits stipulated in this ordinance.

PROMOTION UNDER CARRY-OVER SYSTEM

- i. A candidates who fails in the promotion rules 7.1 (ii) becomes eligible for provisional promotion to next semester and to the carry over system as per the following table.

For promotion to & exam.	Max. Permitted no. of carry-over Papers of semesters			
	I Sem	II Sem	III Sem	IV Sem
Of II Sem	2	-	-	-
Of III Sem	2	2	-	-
Of IV Sem	-	2	2	-

- ii. No separate carry-over examination will be held for any paper except for M.Sc. final year. Any candidate eligible for the carry-over system shall have to appear in the carry-over paper in the subsequent University Examinations for the same semesters. Only one back attempt per paper is allowed.
- iii. Marks obtained in the carry-over examinations shall replace the original marks. Internal assessment will remain unaltered.
- iv. Provisions regarding back papers: a student shall be allowed to appear in a total of 4 (four) back papers in a year, i.e., maximum 2 (two) papers per semesters. A student of First Year's continuation to the second year shall not be stopped subject to the condition that at the time of promotion to the third semester his/her total number of back papers in the first and second semester shall not be more than 4 (four). Those students who have got back papers in more 4 (four) papers up to second semesters shall not be admitted in third semester and shall not be treated as failed and can appear in the examination of the semester in which he/she has failed as an (Ex-students along with the regular student of respective semester. In such case of failed students the marks obtained by them in internal assignment. Seminar and Viva-voce shall be carried forward as they need not repeat them. If the student fails to clear the papers even on a second attempt, i.e., as back paper, such student shall be treated as failed.

8.3. EX-STUDENTSHIP

- i. A student failing in B/P (back paper) exam shall have to appear as an ex-student. If he/she fails again as ex-student, he/she will not be allowed to continue his/her studies further.
- ii. Candidates opting fro ex-studentship shall be required to register within fifteen days of the declaration of end semester result.
- iii. Inter assessment practical, seminar, project and viva-voce marks in the papers of an ex-student shall remain the same as those secured by him/her earlier.

8.4. AWARD OF DIVISION

- i. If a candidate secures aggregate marks of 60% or more at the end of the 4th Semester, he/she will be placed in First Divisions.
- ii. Candidates having aggregate marks of 50% or more, but less than 60% shall be placed in second Division.
- iii. Candidates having aggregate of marks less than 50% shall be declared as failed.

8.5. GRACE MARKS

A grace of maximum 5 marks may be awarded in theory only (maximum two papers) in every semester examination to those candidates who by the award of these

marks can be declared to have passed in all the papers of the semester. Scrutiny shall be allowed as per the rules of the University. Provision of re-checking of answer script will be as per university rules.

9. STRUCTURE OF FEE

As per the decision of the University/Institute/College.

10. CONDUCT AND DISCIPLINE

Students are required to maintain a high standard of discipline and are bound to follow the disciplinary rules framed by university/institute/college. The university/institute/college administration may revise the conduct rules in the interest of the university/institute/college as and when necessary.

Note: For any rules not covered in the above text of ordinances, The text of Ordinances for M.Sc. Microbiology (Semester System) and University Rules & Regulations can be referred to.

H.N.B. Garhwal University, Srinagar – Garhwal
M.Sc. Medical Laboratory Technology (Pathology)

First Semester (Course Structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration	Practical (Max. Marks) + clinical	
			Univ. Exam	Class Test		Univ. Practical	Int. Ass. (Prac.+Job Training)
1.	Clinical Biochemistry	MLT-101	50	10	3 hrs	60	15+05
2.	Bio-Physics & Human Physiology	MLT-102	50	10	3 hrs	60	15+05
3.	Immunology, Vaccinology and Transplantation Technology	MLT-103	50	10	3 hrs	60	15+05
4.	Medical Microbiology	MLT-104	50	10	3 hrs	60	15+05
5.	Clinical Haematology & Blood Banking Technology	MLT-105	50	10	3 hrs	60	15+05
		Total	250	50		300	100

On the job training: 15 days

Total = 700 Marks

M.Sc. Medical Laboratory Technology (Pathology)

Second Semester (Course Structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration	Practical (Max. Marks) + clinical	
			Univ. Exam	Class Test		Univ. Practical	Int. Ass. (Prac.+Job Training)
1.	Diagnostic Biochemistry & Organ Function Test	MLT-201	50	10	3 hrs	60	15+05
2.	Histopathology and Morbid Anatomy Techniques	MLT-202	50	10	3 hrs	60	15+05
3.	Cytology & Cytogenetics	MLT-203	50	10	3 hrs	60	15+05
4.	Diagnostic Microbiology & Immuno Haematology	MLT-204	50	10	3 hrs	60	15+05
5.	Human Genetics & Human Genome	MLT-205	50	10	3 hrs	60	15+05
		Total	250	50		300	100

On the job training: 15 days

Total = 700 Marks

M.Sc. Medical Laboratory Technology (Pathology with Haematology)

Third Semester (Course structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration	Practical (Max. Marks) + clinical	
			Univ. Exam	Class Test		Univ. Practical	Int. Ass. (Prac.+Job Training)
1.	Clinical Haematology Non-Neoplastic	MLT-301 (PH)	80	20	3 hrs	80	20
2.	Clinical Haematology Neoplastic	MLT-302 (PH)	80	20	3 hrs	80	20
3.	Immunohaematology & Advanced Hematologic Techniques	MLT-303 (PH)	80	20	3 hrs	80	20
		Total	240	60		340	60

Total = 600 Marks

“Clinical training and day to day assignment” – 100 marks

This will include regular assessment of the students’ performances in laboratory Work Seminars, Group Discussions, Journal Reviews, Teaching and Learning Sessions and the Health Center Posting. This will act as a performance-check of the students.

Total = 600+100=700 Marks

M.Sc. Medical Laboratory Technology (Pathology with Haematology)

Fourth Semester (Course structure)

Project, which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from 3rd Semester and will continue through the fourth one. The project report will be submitted at the end of the 4th semester & evaluated (50% evaluation by Internal Examiner & 50% evaluation by External Examiner.

Grand total = 700+700+700+400=2500 marks

H.N.B. Garhwal University, Srinagar – Garhwal

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Biochemistry)

Third Semester (Course structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration Hrs.	Practical (Max. Marks)	
			Univ. Exam (Theory)	Int. Assts. (Theory)		Univ. Exam (Theory)	Int. Ass. (Theory)
1.	Advances in Biochemical Sciences	MLT-301 (CB)	80	20	3 hrs	80	20
2.	Intermediary Metabolism & Metabolic Disorders	MLT-302 (CB)	80	20	3 hrs	80	20
3.	Diagnostic Enzymology	MLT-303 (CB)	80	20	3 hrs	80	20
		Total	240	60		240	60

Total = 600 Marks

“Clinical training and Day to Day assignment” – 100 marks

This will include regular assessment of the students’ performances in laboratory Work Seminars, Group Discussions, Journal Reviews, Teaching and Learning Sessions and the Health Center Posting. This will act as a performance-check of the students.

Total = 600+100=700 Marks

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Biochemistry)

Fourth Semester (Course structure)

Project, which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from 3rd Semester and will continue through the fourth one. The project report will be submitted at the end of the 4th semester & evaluated (50% evaluation by Internal Examiner & 50% evaluation by External Examiner.

Grand total = 700+700+700+400=2500 marks

H.N.B. Garhwal University, Srinagar – Garhwal

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Microbiology)

Third Semester (Course structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration Hrs.	Practical (Max. Marks)	
			Univ. Exam (Theory)	Int. Assts. (Theory)		Univ. Exam (Theory)	Int. Ass. (Theory)
1.	General Issues in Clinical Microbiology	MLT-301 (M)	80	20	3 hrs	80	20
2.	Diagnostic Microbiology	MLT-302 (M)	80	20	3 hrs	80	20
3.	Instrumentation & Techniques in Medical Microbiology	MLT-303 (M)	80	20	3 hrs	80	20
		Total	240	60		240	60

Total = 600 Marks

“Clinical training and Day to Day assignment” – 100 marks

This will include regular assessment of the students’ performances in laboratory Work Seminars, Group Discussions, Journal Reviews, Teaching and Learning Sessions and the Health Center Posting. This will act as a performance-check of the students.

Total = 600+100=700 Marks

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Microbiology)

Fourth Semester (Course structure)

Project, which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from 3rd Semester and will continue through the fourth one. The project report will be submitted at the end of the 4th semester & evaluated (50% evaluation by Internal Examiner & 50% evaluation by External Examiner).

Grand total = 700+700+700+400=2500 marks

M. Sc. Medical Lab Technology (Pathology)

Semester-First

Paper-I

Clinical Biochemistry

Code-MMLT 101

Max. Marks: 50

Min. marks: 20

Note: Instruction to the examiner

- There should be minimum of two questions from each unit.
- The students should attempt one question out of two of each unit.
- All the questions carry equal marks.

Unit-I

Principles of the assay procedures for biological materials

- Blood sugar and its metabolism
- Estimation of blood sugar
 - i) God-Pod method ii) Folin-Wu method iii) Orthotoluidine method
- Metabolism of protein
- Estimation of total protein
 - i) BCG method ii) Biuret method
- Estimation of serum albumin
 - i) BCG method
- Serum Creatinine estimation
 - i) Jaffe's method

Lipid profile: Fat, definition, important biological fats, cholesterol, clinical significance of cholesterol. Methods of estimation and the normal levels

- i) Serum cholesterol
 - a) CHOD/ POD method b) Wybengo and Nileggis method
- ii) LDL Cholesterol
- iii) HDL cholesterol CHOD/ POD method
- iv) Triglycerides method GOP/ PA method

Serum Electrolytes: (Their importance and normal blood values)

- i) Na⁺ ii) K⁺ iii) Ca⁺⁺
- T3,T4,TSH(Thyroid Stimulating hormone)

Unit-II

Clinical significance, Principle of estimation

- Bilirubin general, types and jaundice
- Liver function test
 - i) Bilirubin estimation (Mally evlen method, Jendrassik and Grof method, direct spectrophotometric method)
 - ii) Alkaline phosphatase and acid phosphatase estimation by King's method
 - iii) SGOT, SGPT Reatam frank method. ALP, PT etc.
- Glucose tolerance test (G.T.T.), Importance, Principle and techniques of GTT
- Insulin tolerance test
- Gastric juice analysis
- Xylose absorption test
- Analysis of calculi
- Cerebrospinal fluid (CSF)
- Composition and function of CSF
- Clinical significance of CSF analysis
- Estimation of sugar and protein in CSF

Unit-III

Urine chemistry

- Automation in urine chemistry
- Physical and chemical examinations of urine samples; Qualitative tests for inorganic urinary ingredients.
- Common qualitative and quantitative test of urine
- Quality control of clinical investigation
- Automation in clinical biochemistry laboratory
- Laboratory organization, management and maintenance of record

- Normal and abnormal levels
- Clearance test for renal function
- Protein properties
- Protein structure
- Total protein estimation
- Protein purification

Unit-IV

Immunochemical techniques

- General principles
- Production of antibodies
- The precipitation reaction in gels; Immunodiffusion(ID)
- Radio immunoassay(RIA)
- Enzyme-Linked immunoassay(ELISA)
- Fluorescent immunoassay(FIA)

Molecular biology techniques

- Introduction and structure of nucleic acid
- Function of nucleic acid
- Isolation of nucleic acid
- Physical analysis of DNA
- Isolation of specific nucleic acid and sequences

Unit-V

Protein and enzyme techniques

- Enzyme nomenclature
- Steady state enzyme kinetics
- Enzyme assay techniques
- Immobilized enzymes

Centrifugation Techniques

- Basic principles of sedimentation
- Centrifuges and their use

Electrophoretic technique

General principles and introduction to

- Electrophoresis of proteins
- Electrophoresis of nucleic acid

Chromatographic techniques

General principles and introduction to

- Low pressure column chromatography
- High performance liquid chromatography(HPLC)
- Partition chromatography
- Ion-exchange chromatography
- Gas-liquid chromatography(GLC)
- Thin layer chromatography(TLC)
- Paper chromatography

List of practicals:-

1. Estimation of blood glucose by Folin Wu Method, Ortho-Toluidine method & God-Pod method.
2. Estimation of protein by Biuret method, Lowry method, UV method
3. Estimation of Serum creatinine by jaffe's method
4. Estimation of Urea in blood sample by biuret method
5. Estimation of total cholesterol by CHOD/POD method
6. Estimation of Triglyceride by GOP/PA method.
7. Estimation of HDL cholesterol by Precipitation method.
8. Estimation of SGOT in blood sample by kinetic method
9. Estimation of SGPT in blood by kinetic method
10. Estimation of Alkaline phosphatase by Kinetic method
11. Estimation of Acid phosphatase in blood sample by Kinetic method
12. Estimation of bilirubin by Kinetic method
13. Estimation of Na⁺, K⁺ and Ca⁺⁺ by flame photometer and electrode analyzer
14. Estimation of common parameters in urine through use of strips
15. Estimation of T3, T4, TSH by ELISA method
16. Isolation on DNA from blood sample
17. Protein profiling of blood sample by electrophoretic technique
18. Electrophoresis: Native, SDS-PAGE of blood sample.
19. Protein purification by : a) TCA precipitation b) Ammonium Sulphate c) Acetone

M.Sc. MLT First Semester
Paper-II
Biophysics and Human Physiology
Code-MMLT 102

Max. Marks: 50
Min. marks: 20

Note: Instruction to the examiner

- There should be minimum of two questions from each unit.
- The students should attempt one question out of two of each unit.
- All the questions carry equal marks.

Unit-I

Role of Biophysics with relation to Medical Laboratory Technology equipments; Fundamental of physics; Electricity and magnetism; Thermionic emission and its applications; History and development of X-ray tubes; High tension generators; Control and indicating devices; Principles of electronic circuiting.

Unit-II

The structure of biological macromolecules; methods for structural elucidation, conformation of biological system, Polyelectrolyte, Debye –Huckel theory.

Unit-III

Photochemical and photobiological phenomena, Mechanism of photosynthesis, Vision, Absorption and fluorescence, biological energy conservation, Concept of membrane potential and proton flux ion pumps.

Unit-IV

The biophysics of locomotion, generation and propagation of nerve impulse, biophysics of chemoreception, cybernetics and information theory; evolution of life.

Unit-V

Muscle: Types, mechanism of contraction, properties

Cardio-vascular system: Cardiac cycle; blood pressure

Respiratory system: Mechanism of respiration, lung function test

Digestive system: Salivary glands, stomach, liver, pancreas, small intestine, large intestine, digestion and absorption of carbohydrate, fats and proteins

Endocrine system: Pituitary, thyroid, parathyroid and adrenal glands

Excretory system: Glomerular filtration rate (GFR), Urine formation, autoregulation, renal function test

Reproductive system: Male reproductive system; female reproductive system; menstrual cycle, Contraception

Skin and its functions

Nervous system: reflex arc, sensory and motor system.

Semester-First
Paper-III
Immunology, Vaccinology and Transplantation technology
Code-MMLT 103

Max. Marks: 50

Min. marks: 20

Note: Instruction to the examiner

- There should be minimum of two questions from each unit.
- The students should attempt one question out of two of each unit.
- All the questions carry equal marks.

Unit-I

Immune system and immunity: History of immunology, composition and function of cells and organs involved in immune system. Immune responses: evolution of immune response, immunological tolerance, active and passive immunization, innate immunity and acquired immunity. Determinants of innate immunity: Species and strains, individual differences, Influence of age, hormonal influence, nutritional factors and mechanical barriers and surface secretions. Non-specific immune mechanisms: surface defenses, tissue defenses, opsonization, inflammatory reactions, hormone balance.

Unit-II

Antigens and antibodies: Antigens – structure and properties, types-iso and allo haptens, adjuvant, antigens specificity. Immunoglobulin-Structure, heterogeneity,, types and subtypes, properties (Physiochemical and biological).Theories of antibody production. Complement: - structure, components, properties and functions of different components, complement pathways and biological consequences of complement activation. Antigen-antibody reactions: in vitro methods-agglutinations, precipitation, complement fixation, immunofluorescence, ELISA, Radio immunoassay (RIA)

Unit-III

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. Mechanism of cell mediated immunity, immune tolerance to self antigens. Synthesis of antibodies and antibody diversity, Hybridoma technology.

Unit –IV

Immunogenetics: Blood groups and transplantation antigens, Major Histocompatibility complex and tumour immunology: structure and functions and disease association of MHC and HLA-system. Gene regulation and Ir-genes. HLA and tissue transplantation, graft versus host reaction and rejection, Immune suppression-specific and non specific, Autoimmunity-theories, mechanisms and diseases. Tumour immunology-tumour specific antigens, immune response to tumour.

Unit-V

Hypersensitivity reactions: Antibody mediated-type I anaphylaxis, type II antibody dependent cell cytotoxicity, type III immune complex mediated reactions, Type IV cell mediated hypersensitivity reactions. Defects in immune system: Primary and secondary defects, defects in complements, defective phagocyte mechanisms, Allergy, Immunoprophylaxis-types of vaccines and vaccine production, monoclonal antibodies and hybridoma technology.

Practicals:-

- a) Interferon induction-isolation and assay
- b) Development of monoclonal antibodies by hybridoma technology
- c) Production of poly clonal antibodies and testing-immunodiffusion
- d) Immunoelectrophoresis, crossed antigen-antibody electrophoresis, ELISA, RIA, Immunoblotting
- e) Immunofluorescence, agglutination, rosette-formation, Complement fixation
- f) Antigen induced T cell proliferation.
- g) Generation of cytotoxic T lymphocyte

M.Sc. MLT Semester-First
Paper-IV
Medical Microbiology
Code-MMLT 104

Max. Marks: 50
Min. marks: 20

Note: Instruction to the examiner

1. There should be minimum of two questions from each unit.
2. The students should attempt one question out of two of each unit.
3. All the questions carry equal marks.

Unit-I

Systemic Bacteriology

1. Introduction to Systematic Bacteriology
2. Basic trends of classification scope and importance of systematic bacteriology
3. Morphological staining, culture, biochemical characteristics, lab diagnosis etc. of the following:
Staphylococci and Micrococci; Streptococci and Pneumococci; Corynebacterium Diphtheriae; Enterobacteriaceae- I (E.coli, Klebsiella and Enterobacter) , Enterobacteriaceae-II (Salmonella, Shigella and Proteus); Pseudomonas; Vibrio cholerae; Neisseria and Haemophilus; Mycobacteria; Brucella; Bordetella; Clostridia; Leptospira; Mycoplasma; Rickettsia; Chlamydia.

Unit-II

Bacteriological examinations of water, milk, food and air

Bacterial pathogenicity

- i) Definitions of pathogenicity , pathogenesis and virulence
- ii) Sources of infection
- iii) Modes of spread of infections
- iv) Types of infections

Nosocomial infections: Introduction, common types of nosocomial infections, surveillance (Bacteriological) and control of nosocomial infections.

Specimen processing

- i) Blood ii) sputum iii) throat swab iv) Nasopharyngeal swab v) swab (Pus-wound) vi) urine vii) genital discharges and swabs viii) C.S.F. and other body fluids ix) Stool and rectal swab.

Unit-III

Medical Mycology

- General characteristics, morphology and reproduction of medically important fungi.
- Classification of medically important fungi
- Fungi causing superficial mycoses, subcutaneous mycosis and systemic infection
- Antimycotic agents
- Antifungal chemotherapy
- Preparation of culture media for fungi and culture techniques SDA, Corn Meal agar, Rice Starch Agar, slide cultures etc
- Staining of fungi and preparation, storing and processing of samples (KOH Preparation, Lactophenol Cotton Blue etc)
- Contaminants and opportunistic fungi.

Unit-IV

Methods of culturing and assaying of viruses

Classification of viruses

Replication of DNA, RNA +ve RNA–ve viruses, retroviruses

Viral vaccines: conventional: killed / attenuated; DNA; peptide; recombinant proteins.

Introduction to Medical Parasitology: La diagnosis of parasites in stool; blood body fluids.

Diagnostic tests of identification of parasites.

Unit-V

Sterilization techniques: biohazards; containment facilities, BSL 2, 3, 4

Bacterial and viral vectors

Biological warfare agents

Mode of action of antibiotics and antiviral: molecular mechanism of drug resistance (MDR)

Hospital-acquired infections (nosocomial), immune compromised states

Water and waste management for water-borne diseases

Investigations and handling of epidemic

List of Practical

Aseptic practice in laboratory and safety precautions
Care and maintenance of laboratory equipments like water bath, Centrifuges, oven, refrigerator, incubator etc
Preparation of axenic cultures
Preparation and pouring of Media-Nutrient agar, Blood agar, Mac-conkey agar, sugars , serum sugar kligler iron agar, Robertson cooked meat lowen stainjensons agar, sabourads dextrose agar.
Operation of autoclave, hot air oven, distillation plant, filter like Seitze and membrane and sterility test
Preparation of reagents (oxidase, Kovac etc)
Disposal of contaminated materials like cultures etc
Testing of disinfectants- Phenol coefficient and “In use tests “
Quality control of media, reagents etc
Preparation of antibiotic discs, performance of antimicrobial susceptibility test
Processing and identification of pure bacterial cultures
Collection of specimens for microbiological investigations such as blood, urine, throat swab, rectal swab, stool pus swab, C.S.F. and other body fluids and O.T. specimens etc
Processing of water, milk, food, and air samples for bacteriological examinations
Identification of bacterial of medical importance up to species level.
Plating of clinical specimen of media for isolation purification, identification, and quantitations purposes.
Skin test like montoux, lepramin etc
Antimicrobial susceptibility test for microbacteria
To prepare different culture media used in mycology
Staining technique a) KOH preparation b) LCB and c) India ink preparation
To observe characteristics of common laboratory contaminants (fungal)
Collection and processing of samples for diagnosis of fungal infections- Skin, nail, hair, body fluids, and secretions etc
Staining techniques
Haemagglutination test
Commercial kits based diagnosis
Antibiotic sensitivity (bacterial)
Electron microscopic (demo)
Bacterial culture
Agar gel diffusion, ELISA

M.Sc. MLT Semester-First
Paper-V
Clinical Haematology and Blood Banking Technology
Code: MMLT 105

Max. Marks: 50
Min. marks: 20

Note: Instruction to the examiner

- Their should be minimum two questions from each unit.
- The students should attempt one questions out of two each unit.
- All the question carry equal marks

Unit-I

- Introduction, History and Discovery to blood group system
- Human blood group antigen, their inheritance, antibodies, and secreteors.
- ABO Blood Group System,: Sub-groups; Source of antigen, types of antibodies; Rhesus (RH) Blood Group System- Nomenclature and types of antigens ; mode of inheritance ; types of antibodies , techniques of grouping and cross matching
- Coomb's test –direct and indirect test; titration of antibody
- Compability test in blood transfusion, complication and hazards of blood transfusion

Unit- II

- Laboratory investigation of transfusion reactions and miss matched transfusion
- Preparation of packed red cells and various fractions of blood for transfusion purposes
- Blood collection- selection and screening of donor, collection of blood, various anticoagulants, and storage of blood
- Organization, operation and administrations of blood bank
- Structure, collection and significance of bone marrow composition and functions
- Staining of bone marrow smears and preparation of histological sections
- Hemoglobin, its synthesis, functions and degradation
- Haemoglobin pigments and their measurement
- Abnormal haemoglobin and their means of identification and estimation

Unit –III

- LE cell phenomenon and various methods of its demonstration , clinical importance
- Haemostatic mechanisms and theories of blood coagulation
- Physiochemical properties of coagulation factors
- Screening coagulation procedures
- Quantative essay of coagulation factors

Unit –IV

Anatomy and physiology of Hamopoiesis , Anaemias , and other disorders of Erythropoiesis, Disorder of Leucopois, Physiology of Haemostasis and disorder of blood coagulation and fibrinolysis, immunogenetics , 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 , screening coagulation test , preparation of brain thromboplastin , Euglobulin clot lysis , Fibrinogen level, FDPS , Blood grouping and matching , Coomb's test, Agglutination techniques, Serum Fe , Iron binding capacity , Investigation of nutritional anemia's

Unit –V

Artificial blood
Iron metabolism and its disorder
Antigens to blood groups,
Components of Blood and its preservation
Mechanism of Haemostatics
Blood components separator
Essentials of Blood Banks
Role of Blood as a parameter of diagnostic industry
Basic principles and clinical aspects of cell counter
Electrode analyzer
Artial blood gas analyzer

M. Sc. Medical Lab Technology (Pathology)

Semester-Second

Paper-I

Diagnostics Biochemistry and Organ Function Test

Code: MMLT 201

Max. Marks: 50

Min. marks: 20

Note: Instruction to the examiner

- There will be two questions from each unit
- The students should attempt one question from each unit
- All questions they carry equal marks

Unit – I

Quality control, GMP and GLP, records

Biochemical disorders

Immune disorders

Genetic disorders, chromosomal disorders, single cell disorders and complex traits

Unit – II

Chromosomal disorders: autosomal; sex chromosomal; karyotype analysis. G-banding, *in situ* hybridization (FISH and on –FISH), and comparative genomic hybridization (CGH).

Unit – III

Cancer cytogenetics; special karyotyping. DNA diagnostics: PCR based diagnostics, ligation chain reaction, southern blot diagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism.

Haemoglobinopathies Neuro developmental disorders, Neuro degenerative disorders. Dynamic mutations.

Unit – IV

Biochemical diagnostics: inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders. Immunodiagnostics: diagnosis of infectious disease and mycobacterium diseases.

Phage display, Immunoarrays, FACs.

Unit – V

Organ function tests- biochemical diagnosis and assessment of diseases of liver, kidney, pancreas, thyroid, muscle and CNS, and adrenals. Malabsorption syndromes and their biochemical evaluation. Blood and disorders- biochemical derangement in anemia. Enzymes and isoenzymes and their application in various disorders. Disturbances in acid-base balance. Lipoproteins and its disorders. Diabetes and atherosclerosis.

Practical:

1. G-banded chromosomal preparation for detection of autosomes of autosomal/sec.
2. Chromosomal disorders (translocation, deletion, Down's syndrome, Klinefelter syndrome, Turner's syndrome, etc).
3. FISH for detection of : translocations, inversions (using appropriate probes) (eg, chro 9-22 translocation; X-Y translocation).
4. PCR base diagnosis (e.g. fragile-X syndrome; SRY in sex chromosomal anomalies).
5. Native PAGE analysis of enzyme.
6. Isozyme analysis of enzyme variants.
7. Hormonal detection by ELISA Kits.
 - a) T3 b) T4 e) TSH f) LSH
 - c) Free T3 d) Free T4 g) FSH h) Prolact

M.Sc. MLT Semester-Second
Paper-II
Histopathology and Morbid Anatomy Technique
Code: MMLT 202

Max. Marks: 50
Min. marks: 20

Note: Instructions to the examiner

- There will be two questions from each unit
- The students should attempt one question from each unit
- All questions they carry equal marks

Unit – I

Theory lectures / Seminars / Group Discussions:

General Pathology and Cytology of tumors:

Pathology and Cytology of female genital tract. (8 sections)

- i. Anatomy, embryology, histology and physiology of female genital tract.
- ii. Cytology of female genital tract and normal vaginal flora.
- iii. Inflammatory lesions of vagina and cervix.
- iv. Cytology of benign disorders of epithelia of uterine cervix and vagina.
- v. Precancerous of cancerous lesions of cervix
- vi. Effect of therapeutic procedure such as radiotherapy and drugs on epithelia of female genital tract.
- vii. Significance of cervical cancer screening.
- viii. Hormonal cytology in various age groups.

Unit II

- i. Histology and Cytology of normal respiratory tract.
- ii. Cellular abnormalities due to benign disorders of respiratory tract.
- iii. Etiopathogenesis of lung cancer and method of cytodiagnosis of lung cancer.
- iv. Cytological morphological characteristics of primary versus secondary lung carcinoma.
- v. Importance of lung cancer screening and accuracy of pulmonary cytology.
- vi. Role of cytologic techniques in diagnosis of cancer

Unit III

- i. Urinary tract
- ii. Anatomy, histology and cytology (normal urine)
- iii. Etiopathogenesis of bladder cancer and role of urinary cytology in diagnosis of bladder cancer and cancer of other sites.
- iv. Cytology of urothelial cancer.
- v. Gastrointestinal tract.
- vi. Anatomy, histology and normal cytology.
- vii. Cytology of malignant tumors.

Unit IV

- i. Effusions, Anatomy, Histology and cytology of pleural peritoneal and pericardial cavities.
- ii. Benign and malignant cell population in effusions.
- iii. Cytology of cerebrospinal fluid and miscellaneous fluids.
- iv. Aspiration biopsy cytology-general principles of technique and cytodiagnosis.
- v. Breast and Nipple secretions
- vi. Anatomy and histology of breast
- vii. Cytology of nipple secretions and breast aspirates

Unit V

- i. Automation in cytology laboratory
- ii. Application of flow cytometry
- iii. Etiology of cancer and methods of tumor induction
- iv. Sex chromatin and chromosomal abnormalities in cancer

Practical:

1. Method of Disinfection - Preparation of Distill Water
2. Fixilation and various fixatives
3. Decalcification
4. Processing
5. Sections and types of Microtomes
6. Staining – Methods and preparation of Staining H & E Staining.
7. Methods of staining preparation – Routine Staining..H & E Stain..,PAP mStain, Geimsa, Pas Stain, Vinkossa Staining
8. AFB Staining
9. Pars – Persion blue for RH

M.Sc. MLT Semester-Second
Paper-III
Cytology and Cytogenetics
Code: MMLT 203

Max. Marks: 50
Min. marks: 20

Note: Instructions to the examiner

- There will be two questions from each unit
- The students should attempt one question from each unit
- All questions they carry equal marks

Unit – I Cytologic Techniques

In addition to the rotational posting to look after the routine laboratory procedures, (Hospital Service Part), the candidate shall take learn the following special laboratory procedures:

Methods of preparation of fluids for microscopic examination:

- a) Preparation of direct or sediment smears
- b) Cytocentrifuge preparation
- c) Preparation with membrane filters
- d) Preparation cell blocks
- e) Processing of haemorrhagic fluids
- f) Methods of preparation of cell suspensions

Unit – II

- Technique of processing of cytologic samples for electron microscopic examination
- Different staining techniques for sex chromatin
- Direct technique of chromosomal analysis in tumors and karyotyping
- Special staining techniques (including background of staining reaction of each); Mucus, Glycogen, Lipids, Pigments.
- Enzyme cytochemistry; Acid and alkaline phosphatase and peroxidase.
- Methods of monoclonal antibody staining in smears.

Unit III

Correction of technical errors in preparation and staining of cytological smears.

Methods of disinfection, cleaning of glassware / laboratory equipments used in collection and processing of specimens, sterilization of equipments / instruments / syringes and needles / solutions for special laboratory use. Preparation of distilled water, saline and buffers commonly used for special cytological techniques.

Unit IV

Light microscope, working and its applications
Phase contrast microscope working and its application
Electron microscope: working and application
Fluorescent microscope: working and application
Methods of examination under polarizing light and dark ground illumination

Unit V

Methods of specimen collection
Cervical smear for malignant cytology
Vaginal smear or hormonal cytology
Methods of pleural and pericardial tapping
Methods of sputum induction in cases with non-productive cough
To see the endoscopic procedures for collection of Brush cytology specimens from tracheobronchial tree, Oesophageal and gastric lesions
Principles of techniques of fine needle aspiration biopsy.

Practical Diagnostic Experience :

1. Cervical Cancer Screening
2. Identification of normal , inflammatory, metaplastic dysplastic and malignant cells
3. Identification of specific infections , Trichomonas vaginalis , candidiasis , Actinomyces, Herpes , genital condylomatous lesions
4. Identification of cells foreign to cervix

5. Hormonal cytology : Calculation of hormonal indices and its interpretation
Identification of benign and malignant cells in the following types of Specimens:
- i) Sputum and bronchial brush cytology
 - ii) Esophageal and Gastric brush cytology
 - iii) Oral Scraping
 - iv) Effusions
 - v) C.S.F and other body fluids
 - vi) Urine
 - vii) Breast aspiration smears and nipple discharge

M.Sc. MLT Semester-Second
Paper-IV
Diagnostic Microbiology and Immunopathology
Code: MMLT 204

Max. Marks: 50

Min. marks: 20

Note: Instructions to the examiner

- There will be two questions from each unit
- The students should attempt one question from each unit
- All questions they carry equal marks

Unit I

Infrequently Occurring Pathogens: (transmission, epidemiology, Pathogens, and Clinical disease, Diagnosis) Brucellosis, Tularemia, Pasteurella infections, Aeromonas and Plesiomonas, Gardnerella and Mobiluncus.

Unit- II

Opportunistic Fungal Pathogens : (Pathogenesis and Lab Diagnosis) Candidiasis, Pneumocystosis, Cryptococcosis , Penicilliosis marneffei, Aspergillosis, Zygomycosis, Laboratory methods in basic Virology (Cytopathologic effects , Electron Microscopic , Isolation , and Growth of viruses, Detection of virus , Detection of virus components
Proteins, Enzymes and Immune response to virus Serology). In Reference to: CMV, Rubella, Polio, Rabies, HBV, HCV, HIV, Retro HPV

Unit- III

HLA, Major Histocompatibility Complex (MHC)
Principles of Immunogenetics applied to MHC
Basic genetics, Biochemistry, Characterisation and Blood grouping procedure of ABO blood group system.
Basic genetics, Biochemistry, Characterisation and Blood grouping procedure of Rh system.
Other blood group (Lewis, MNSs, KELL, DUFFY and KIDD blood group systems and antibodies.)
Immunoglobulin and Paraproteins
Complement System
Tumor Immunology

Unit – IV

Basic Principle of Immunohaematology.(Antigen, Antibody, structure of Immunoglobulin Molecule, Immune response, Immune antibodies and factors affectin antigen and antibody reaction).
Compatibility testing, Blood collection and processing and preservation & storage of blood.

Blood groups antigens, immune response to blood banking, blood groups antibodies complement and Blood banking
Immunologic reactions involving erythrocytes
Transfusion Reaction

Unit – V

Blood component preparation and therapy.
Apheresis
Transfusion practice in clinical medicine.
Blood transfusion reactions.
Immunization association in pregnancy and Haemolytic disease of new born (HDN)
Quality assurance in Blood transfusion services.
Erythrocytes antigen and antibodies
ABO Systems, Rh-System
Other erythrocytes antigens and antibodies
Paternity Testing
Immunization association in pregnancy

Practical:

1. Typing of erythrocytes, Antigen and Antibodies (ABO and Rh)
2. Direct Coomb's Test
3. Indirect Coomb's Test
4. Major and Minor errors matching
5. HBSAg testing
6. Malaria , Syphilis
7. Handling of various laboratory instrument, cleaning, reagent preparation and drawing of the graph.
8. Principles application and maintenance of following laboratory equipments (Immunoelectro Microscope
9. pH meter, Spectrophotometer including ELISA
10. Anti-D titration
11. Preparation of Antigen and Standardizing them

Semester-Second
Paper –V
Human Genetics and Human Genome
Code: MMLT 205

Max. Marks: 50
Min. marks: 20

Note: Instruction to the examiner

- There will be two questions from each unit
- The student should attempt one question from each unit
- All questions they carry equal marks.

Unit –I

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.

Unit –II

Methods for genetic study in man-pedigree analysis, chromosomal analysis, biochemical analysis.
Somatic cell genetics (somatic cell hybrids, monochromosome, hybrid panels, gene mapping, hybridoma technology, polyclonal and monoclonal antibody), molecular genetics analysis.
Tissue culture techniques, long-term and short term cultures, lymphoblastoid cell lines; congenital abnormalities; clinical aspects of autosomal and sex chromosomal disorder; inborn errors of metabolism, haemoglobinopathies.

Unit –III

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.

Unit- IV

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.

Unit –V

Immunogenetics; pre-natal diagnosis – chorionic villus sampling, amniocentesis.
Pre-implantation diagnosis.
Genetic diagnosis.
Genetic counseling.
Gene therapy-concept, vectors, gene targeting and tissue specific expression.
Ethics and human genetics.
Introduction to pharmacogenomics and toxicogenomics.

Practical of Human genetics

- i. Pedigree analysis
- ii. Chromosome preparation PHA- stimulated short term blood cultures, air dried chromosome preparation.
- iii. G-banding of chromosome.
- iv. Karyotype preparation.
- v. In situ hybridization-FISH (example with centromeric and telomeric probes).
- vi. Polyacrylamide gel electrophoresis- detection of enzyme.(for example G6PD, and X-linked enzyme).

M. Sc. Medical Lab Technology (Pathology with Haematology)

Semester-Third Paper-I Clinical Haematology (Non-Neoplastic) Code: MMLT 301(PH)

Max.marks-80
Min. marks-32

Instructions to the Examiner

1. 20 marks are allotted to each unit
2. Questions from all the units are mandatory

UNIT-1

- **Hematopoiesis-** Theories of Hematopoiesis (origin and development of Blood cells)
- Normal Erythropoiesis, Role of Erythropoietin in Erythropoiesis, destruction of Erythrocytes
- Leucopoiesis (development and maturation of granulocytes and non-granulocytes), antigen independent and antigen dependent lymphopoiesis
- Megakaryopoiesis-stages of megakaryocyte development and release of platelet, micro-megakaryocytes

UNIT-2

- **Disorder of Red cell-Anemia**-Definition, Normal Erythrocytes kinetics and pathophysiology, various classification of Anemia and adaptive mechanism in Anemia, Lab diagnosis of Anemia
- Iron metabolism and Heme synthesis, Iron Deficiency in Anemia of chronic disorder, sideroblastic Anemia, hemochromatosis, porphyria
- Hereditary disorders of Haemoglobin structures and synthesis.
- Structural variants of haemoglobin, pathophysiology of structural haemoglobin variants, sickle cell Anemia with lab diagnosis
- Thalassemia, definition, types of thalassemia including Alpha, Beta thalassemia, pathophysiology and lab diagnosis
- Hemolytic Anemia-Classification, intrinsic and extrinsic, hemolytic Anemia, hereditary spherocytosis, hereditary elliptocytosis, PNH, G6PD and Pyruvate kinase deficiency, HUS, TTP, IDC
- Immune hemolytic Anemia: classification, pathophysiology and lab diagnosis
- Megaloblastic Anemia, Pathophysiology and lab diagnosis

UNIT-3

- **Disorder of White Blood Cells:** Neutrophilia, Leukemoid reaction, neutropenia, morphologic abnormalities of neutrophils, functional abnormalities of neutrophils, reactive eosinophilic and hyper eosinophilic syndrome, lymphocytosis, infectious mononucleosis, lymphocytopenia

UNIT-4

- **Hemostatic mechanisms, Disorder and Lab Diagnosis:** Role of platelet in hemostasis, lab investigation of primary hemostasis
- Secondary hemostasis, coagulation factors, coagulation pathways-intrinsic and extrinsic, fibrinolytic system, screening test for coagulation and fibrinolysis.
- Platelet disorders in primary hemostasis
- Von-Wille Brand disorder, factor VIII & IX deficiency, fibrinogen deficiency, lupus like anticoagulant, thrombosis and conditions pre-disposing to thrombosis, heparin anticoagulants

M. Sc. Medical Lab Technology (Pathology with Haematology)

Semester-Third
Paper-II
Clinical Haematology (Neoplastic)
Code: MMLT 302(PH)

Max.marks-80

Min. marks-32

Instructions to the Examiner

1. 20 marks are allotted to each unit
2. Questions from all the units are mandatory

UNIT-1

- Principles of diagnosis of hematopoietic-Lymphoid neoplasm
- Classification of hematopoietic neoplasm
- Classification of lymphoid neoplasm
- Cancer biology

UNIT-2

- 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
- Complication of hematopoietic neoplasm: host defense defect, haemorrhagic, neurologic, metabolic complication, organ infiltration, ocular, renal, anemia, abdominal, musculoskeletal complications

UNIT-3

- Hematopoietic growth factor, their application in hematologic neoplastic conditions
- Hematopoietic stem cell transplantation and its applications
- Tumor antigens.
- Cytokines, interferon, interleukins, their role in hematologic neoplastic conditions

UNIT-4

- Classification of acute leukemia's
- Acute lymphoblastic leukemia's, clinical features, diagnosis, classification and risk factor assessment
- Acute myelogenous leukemia's, epidemiology, clinical features, immunophenotypes, classification, clinicopathologic syndromes and special types
- Myelodysplastic syndromes: classification, diagnosis, clinical features, pathogenesis, biologic features and lab findings
- Chronic myeloid leukemia's: history, incidence, clinical features, diagnosis, bone marrow findings, cytogenetic findings, immunophenotypes and molecular findings, cellular and molecular pathogenesis
- Polycythemia vera: history, epidemiology, clinical feature, blood and lab findings, bone marrow study, cytogenetic and pathogenesis
- Myelofibrosis: History and pathogenesis, clinical features, lab finding and diagnosis
- Chronic lymphocytic leukemia: Aetiology, clinical findings, lab findings and staging
- Non Hodgkin's lymphomas: aetiology, clinical features, classification and lab findings
- Hodgkin Disease: Aetiology, epidemiology, clinical feature and staging and lab diagnosis
- Plasma cell dyscrasis: Aetiology, cytogenetic and molecular biology, protein abnormalities, clinical features and lab diagnosis

M. Sc. Medical Lab Technology (Pathology with Haematology)

Semester-Third

Paper-III

Immunopathology and advance hematology techniques

Code: MMLT 303(PH)

Max.marks-80

Min. marks-32

Instructions to the Examiner

1. 20 marks are allotted to each unit
2. Questions from all the units are mandatory

UNIT-1

- 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 anti body
- Immuno hematology test and procedures, factors affecting haemagglutination, compatibility testing, anti human globulin test
- New techniques and automation

UNIT-2

- 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

UNIT-3

- Component preparation and uses
- Organization, planning and management of blood bank
- Licensing of blood bank
- Quality control in blood banking
- Special situations hemapheresis, plasmapheresis and leucopheresis

UNIT-4

- Flow cytometry: principle ,instrumentation and application of flow cytometry
- Advance monoclonal antibody testing and procedures
- Advance cytogenetic method and their hematologic application
- Molecular genetic and its application in hematology, PCR, hybridization, stem cell therapy and gene therapy

M. Sc. Medical Lab Technology (Pathology with Hematology)

Fourth Semester

Project work which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from the 3rd semester and will continue through the 4th one. The project report will be submitted at the end of the 4th semester and evaluated (50% evaluation by internal examiner and 50% evaluation by external examiner)

Grand Total= 700 + 700 + 700 + 400 = 2500 marks

H.N.B. Garhwal University, Srinagar – Garhwal

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Biochemistry)

Third Semester (Course structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration Hrs.	Practical (Max. Marks)	
			Univ. Exam (Theory)	Int. Assts. (Theory)		Univ. Exam (Theory)	Int. Ass. (Theory)
4.	Advances in Biochemical Sciences	MLT-301 (CB)	80	20	3 hrs	80	20
5.	Intermediary Metabolism & Metabolic Disorders	MLT-302 (CB)	80	20	3 hrs	80	20
6.	Diagnostic Enzymology	MLT-303 (CB)	80	20	3 hrs	80	20
		Total	240	60		240	60

Total = 600 Marks

“Clinical training and Day to Day assignment” – 100 marks

This will include regular assessment of the students’ performances in laboratory Work Seminars, Group Discussions, Journal Reviews, Teaching and Learning Sessions and the Health Center Posting. This will act as a performance-check of the students.

Total = 600+100=700 Marks

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Biochemistry)

Fourth Semester (Course structure)

Project, which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from 3rd Semester and will continue through the fourth one. The project report will be submitted at the end of the 4th semester & evaluated (50% evaluation by Internal Examiner & 50% evaluation by External Examiner.

Grand total = 700+700+700+400=2500 marks

M. Sc. Medical Lab Technology (Pathology with Clinical Biochemistry)

Semester-Third

Paper-I

Advances in Biochemical sciences

Code: MMLT 301(CB)

Max.marks-80

Min. marks-32

Instructions to the Examiner

3. 20 marks are allotted to each unit
4. Questions from all the units are mandatory

Unit I

Signal Transduction

Hormone Receptors, Hormone Classification, Peptide, Steroid and tyrosine derivatives, Signal Transduction by different groups of hormones. Hormone action by Calcium and calmodulin

Unit II

Metabolism of Xenobiotics

Xenobiotics, Cytochrome P450, Phase I and Phase II reaction, affect of age and sex on activities of Xenobiotic metabolizing enzymes. Salicylate – Poisoning, Heavy Metals-Lead, Mercury, Zinc poisoning and preventive measures

Unit III

Biochemical and Genetical Basis of Disease

Biochemical basis of disease, molecular basis of disease, Major classes of genetic disease, diagnosis and treatment, molecular medicine.

Unit IV

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, Fast, Human Genome Project, Application in Medical Science.

M.Sc. MLT Semester-Third
Paper-II
Intermediary metabolism and metabolic disorders
Code: MMLT 302(CB)

Max.marks-80

Min. marks-32

Instructions to the Examiner

5. 20 marks are allotted to each unit
6. Questions from all the units are mandatory

Unit – I

Biological Oxidation : Oxidation and reduction, oxidases, Dehydrogenases, Hydroperoxidases, oxygenases and mono oxygenase.

Unit – II

Carbohydrate Metabolism : Metabolism of Glycogen, Glycogenesis, Glycogenolysis, Hormonal regulation, Regulation of Glycogen metabolism, Gluconeogenesis, futile cycles, blood glucose level regulation, cori cycle, Glucose transport and transporters. Clinical significant of gluconeogenesis, Pentose phosphate PATHWAY. Diabetes, Ketosis, Hypoglycemia, Glycogen-Storage diseases.

Unit – III

Lipid Metabolism : Lipid Transport and storage, Plasma Lipoproteins, Apolipoproteins, Lipoprotein metabolism, Clinical Significance of Lipoprotein. Cholesterol synthesis and regulation Hyperlipidimia, Atherosclerosis.

Unit – IV

Amino Acid Metabolism : Amino acids, Biosynthesis and clinical significance of Polyamine, Nitric Oxide, Histamine, Serotonin, Melatonin, Creatinine, Melanin and GABA (γ - Amino by tyrate). Phenyl ketonurea, Tyrosinimia and other amino acid metabolic disorders. Introduction to nucleic acid metabolism, denovo and salvage pathway and disorders of purine and pyrimidine metabolism.

M.Sc. MLT Semester-Third
Paper-III
Diagnostic-Enzymology
Code: MMLT 303(CB)

Max.marks-80

Min. marks-32

Instructions to the Examiner

7. 20 marks are allotted to each unit
8. Questions from all the units are mandatory

Unit – I

Historical perspectives, 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) Enzyme specificity types and theories (Lock and key, induced fit and three points attachment) Riboenzymes and Abzymes. Isolation and purification of enzyme, criteria of homogeneity of enzymes.

Unit – II

Enzyme Kinetics

Factor affecting enzyme activity enzyme concentration, substrate concentration, pH and temp. Derivation of Michaelis-Menten equation of unisubstrate reaction K_m and its significance, K_{cat} / K_M and its importance, measurement of K_m and V_{max} line Lineweaver-Burk and other linear transformation, Bisubstrate reaction. Enzyme inhibition, types of reversible inhibition competitive, uncompetitive, derivation of equation for different types of inhibitors, determination of K_i .

Unit – III

Role of cofactor in enzyme catalysis $NAD^+ / HADP$, FMN / FAD coenzyme A, TPP, PLP, Lipic acid, Vitamin B12 and tetrahydrofolic. Factors contributic to enzymatic catalysis proximity and orientation, acid base catalysis, covalent catalysis mechanism of action of chymotrypsin and Lysozyme.

Control of enzyme acitcvtv feed back inhibition, allsotric control with special reference to asparate trans carbomylase. Sigmodial kinetics, concrted and sequential model for action of allostric enzyme. Reversible and irreversible modification of enzyme.

Unit – IV

Protein legend interaction. Biding of protein to legend having single binding site and two binding site, cooperatively phenomena and Scatchard plot. Clinical significance of CPK, CK MB, LDH, SGOT, SGPT, Cholinestrse amylase, lipase aldolase alkaline and acid phosphate. Central of enzymatic activity feed beck inhibition,

M. Sc. Medical Lab Technology (Pathology with Clinical Biochemistry)

Fourth Semester

Project work which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from the 3rd semester and will continue through the 4th one. The project report will be submitted at the end of the 4th semester and evaluated (50% evaluation by internal examiner and 50% evaluation by external examiner)

Grand Total= 700 + 700 + 700 + 400 = 2500 marks

H.N.B. Garhwal University, Srinagar – Garhwal

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Microbiology)

Third Semester (Course structure)

S.No.	Theory Paper	Paper Code	Max Marks		Paper duration Hrs.	Practical (Max. Marks)	
			Univ. Exam (Theory)	Int. Assts. (Theory)		Univ. Exam (Theory)	Int. Ass. (Theory)
1.	General Issues in Clinical Microbiology	MLT-301 (M)	80	20	3 hrs	80	20
2.	Diagnostic Microbiology	MLT-302 (M)	80	20	3 hrs	80	20
3.	Instrumentation & Techniques in Medical Microbiology	MLT-303 (M)	80	20	3 hrs	80	20
		Total	240	60		240	60

Total = 600 Marks

“Clinical training and Day to Day assignment” – 100 marks

This will include regular assessment of the students’ performances in laboratory Work Seminars, Group Discussions, Journal Reviews, Teaching and Learning Sessions and the Health Center Posting. This will act as a performance-check of the students.

Total = 600+100=700 Marks

M.Sc. Medical Laboratory Technology, (Pathology with Clinical Microbiology)

Fourth Semester (Course structure)

Project, which will carry 400 marks

The project will be based upon the research and actual bench work. It will begin from 3rd Semester and will continue through the fourth one. The project report will be submitted at the end of the 4th semester & evaluated (50% evaluation by Internal Examiner & 50% evaluation by External Examiner.

Grand total = 700+700+700+400=2500 marks

M. Sc. Medical Lab Technology (Pathology with Clinical Microbiology)

Semester-Third

Paper-I

General Issues in Clinical Microbiology

Code: MMLT 301(M)

Max.marks-80

Min. marks-32

Instructions to the Examiner

1. 20 marks are allotted to each unit
2. Questions from all the units are mandatory

Unit – I - Epidemiology of Infectious diseases, hospital acquired infection management of hospital waste, Investigation of an infection out break. Animal and human ethics involved in Microbiological work

Unit – II - **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.**

Unit – III - **Statistical Analysis Of Microbiological Data And Research:** Introduction to Mean, Mode, Median, Mean deviation, standard deviation, coefficient of variation correlation and Regression analysis.
Theorems: Probability and simple binomial distribution sampling – t, Z and F test of significance, small and large samples of medical significance Chi-square test.

Unit – IV **-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. Introduction to algorithms and flowcharts. Application in Medical Microbiology and information communications (data bases, emails, local networks).

Semester-Third
Paper-II
Diagnostic Microbiology
Code: MMLT 302(M)

Max.marks-80

Min. marks-32

Instructions to the Examiner

1. 20 marks are allotted to each unit
2. Questions from all the units are mandatory

- Unit – I - Bacteriology :-** 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.
- Laboratory diagnosis of bacterial diseases – Diphtheria, Tuberculosis, Typhoid, Syphilis, Gonorrhea, Urinary Tract Infections, Food Poisoning.
- Unit – II - Mycology:-** classification of fungal diseases - Superficial, Cutaneous, Subcutaneous and Systemic Mycetes, Opportunistic infections.
- Transmission of fungal diseases, Immunity to fungal diseases – Laboratory diagnosis of fungal diseases In-vitro antifungal susceptibility testing, antifungal drug resistance.
- Unit – III - Parasitology and virology -** Processing of body fluids and stool specimen for identification of parasites culture techniques and animal inoculation methods for identification of parasites.
- Cultivation of animal viruses
- Viral serological and molecular techniques.
- Unit – IV-** Immunology Immunity to infectious agents, Measurement of humoral response, cell mediated response, Phagocytic uptake and killing, Recombinant vaccines.
- Immunological techniques :- Immuno blotting, ELISPOT, Complement fixation, RIA and immuno fluorescence.
- Hypersensitivity reactions.

Semester-Third
Paper-III
Instrumentation & Techniques in Medical Microbiology
Code: MMLT 303(M)

Max.marks-80

Min. marks-32

Instructions to the Examiner

1. 20 marks are allotted to each unit
2. Questions from all the units are mandatory

Unit – I - Role of the Microbiologist:- Responsibility to the patient and clinician. General Concept for specimen collection and handling. **Lab physical Design and Organization** – Lab Design with report to safety of air handling system, Mechanical system, walls, floors, ceilings and furniture, Institution. Organization of the Microbiology laboratory.

Unit – II – Microscopy – Principles, application of light microscopy dark field microscopy, fluorescence microscope, Electron microscopy TEM, SEM,
Automation in microbiology.
Preparation of stains – Gram, Alberts, Capsule, Spore, Ziehl, Neelsen, Lactophenol Cotton Blue, Preparation of reagents used in biochemical analysis.

Unit – III - Instrumentation Techniques: Centrifugation Basic principles and common centrifuges used in Laboratory. (Clinical high speed & ultra, Electrophoresis General Principle, application of Gel electrophoresis, PAGE, Agarose Gel electrophoresis Spectroscopy UV – VIS absorption Spectroscopy, Flow Cytometry Principle and application.

Unit – IV- Molecular and Techniques and Bioinformatics – Polymerase Chain Reaction, Micro array, Southern Blotting, Northern Blotting, Western blotting Immunofluorescence and gel documentation. Introduction to Bioinformatics Gene annotation, DNA sequence data, Homology search of DNA and amino acids, BLAST, FASTA, Human Genome Project.