

**JAWAHARLAL INSTITUTE OF POSTGRADUATE
MEDICAL EDUCATION & RESEARCH
(JIPMER)
PUDUCHERRY**



**MSc MLT PATHOLOGY
CURRICULUM**

2021

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JIPMER

Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry (JIPMER) under Government of India since the year 1956, is one of the leading Medical Institutions of India. Spread over a sprawling 195-acre campus in an urban locale of Puducherry (formerly Pondicherry), JIPMER is 170 kms by road from Chennai.

JIPMER has been declared as an “Institution of National Importance” by an Act of Parliament, JIPMER, Puducherry, Act, 2008. A copy of the Act was Gazette notified on 14-7-2008 to enforce this Act. Prior to this, the Institute was functioning under the administrative control of Directorate General of Health Services, Ministry of Health and Family Welfare, New Delhi. The Institution is now empowered to award Medical Degrees under the clauses 23 & 24 of the said Act. Such Degrees shall be deemed to be included in the schedules to the respective Acts governing Medical Council of India/National Medical Commission, Indian Nursing Council, and Dental Council of India, entitling the holders to the same privileges as those attached to the equivalent awards from the recognized Universities of India.

JIPMER imparts Undergraduate (UG), Postgraduate (PG) and Super Specialty Medical Training through a large hospital complex (JIPMER Hospital) and a Nursing College. Some of the courses offered are MBBS., BSc., MSc., MD., MS, DM., and MCh. Courses. Full-time Ph.D. Programs are available in several disciplines.

DEPARTMENT OF PATHOLOGY

The department of Pathology started way back at the inception of JIPMER in 1964. Over the years, it has developed into a multidisciplinary department with a well-developed undergraduate and postgraduate training programme. Among the various activities of this department (apart from teaching), able patient care service including 24-hour emergency lab services, research, and role of faculty in other corporate activities are but just the tip of the iceberg. There has been a constant growth in the workload of the department with a consistent improvement in terms of quality, efficiency, efficacy, and effectiveness as well as, the stakeholder experience. The department has a robust system of providing accurate reports with the reviewing faculty in each subspecialty. As an extension of the patient care service, the department conducts the regular multi-disciplinary team meetings. It also extends the referral services for cancer diagnosis in and around Puducherry, and community service to PHC for screening cervical cancer and blood counts. The departmental research work is presented at regional, national, and international forums and published in peer reviewed journals.

2. Course details:

2.1 Nomenclature of the course:

MSc MLT Pathology

2.2 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. Post Graduate programme in Medical Laboratory Technology MSc MLT (Pathology) gives opportunity for specialized study in the field of Medical Laboratory Technology for BSc (MLT)/Bachelor of medical laboratory sciences graduates.

The specialization in laboratory technology in the field of Pathology requires an advanced knowledge of anatomy, histology, haematology, blood transfusion, histopathology, clinical pathology, and cytology inclusive of special laboratory techniques and use of sophisticated equipment.

2.3 Objectives:

1. To possess an in-depth understanding of the fundamentals and principles of various laboratory procedures done in Pathology including blood bank
2. To be able to perform routine and special laboratory investigations in haematology and cytology and histopathology laboratory
3. To establish a modern pathology laboratory and to manage the laboratory with organizational skills
4. To perform the quality control of laboratory tests in Pathology
5. To possess a full working knowledge about the functioning and performance all the automated instruments of Haematology, Histopathology, Cytology and Blood Banking
6. To be able to function as effective educators and conduct independent research work in the field of Medical Laboratory Technology

3. Regulations:

3.1 Eligibility:

Only Indian citizens are eligible for admission to the course. A regular BSc MLT (Medical Laboratory Technology)/Bachelor of Medical laboratory sciences (BMLS) degree from a University/Institute, recognized by JIPMER, with minimum of (50%) marks for all the years of BSc (MLT) examination taken together.

3.2 Method of Selection

Candidates applying for the MSc MLT (Pathology) course will be selected based on merit in the common All India Entrance examination conducted by the by the institute. The syllabus for the entrance examination will be of BSc MLT/BMLS standard.

3.3 Candidates intake per year:

Five candidates will be admitted to the course every year. There is no provision for sponsored / nominated candidates.

3.4 Duration of the course

2 years (24 months) duration including the completion of project from the date of joining irrespective of the date of exit exam.

3.5 Medium of instruction:

English

3.6 Vacation

As per institute guidelines, students will be eligible for 15 days' vacation in summer and 9 days in winter.

3.7 Subject details:

Year	Paper	Title of the paper
I year	I	Basic Hematology and Blood Banking
	II	Basic Histopathology and Laboratory organization in Pathology
	III	Basic Cytology and Clinical pathology
II year	I	Advanced Hematology
	II	Advanced Histopathology
	III	Advanced Cytology

3.8 Training pattern: Theory, Practical and hands-on work in the laboratory including emergency laboratory services

First year

Basic Hematology and Blood Banking

Basic Histopathology and Laboratory organization in Pathology

Basic Cytology and Clinical pathology

Second year

Advanced Hematology

Advanced Histopathology

Advanced Cytology

Blood Banking and Clinical Pathology

Postings schedule:

First year

1. Hematology (3months)
2. Histopathology (3months)
3. Cytology (3 months)
4. Blood Banking + Clinical Pathology (1.5 months each)

Second year

1. Hematology (4months)
2. Histopathology (4months)
3. Cytology (4 months)
4. Modules in Biostatistics and Molecular Biology - Two modules of six classes, one each for biostatistics and for molecular biology to be conducted in Second year. These modules will be held in common with the MSc MLT Microbiology students. Formative assessment will be done at the end of each module.

Course Methodology:

Total involvement in laboratory work, basic to advanced techniques in the sections posted in the department of Pathology as the whole-time in-service training, including emergency laboratory services.

1. Lectures 2-3 hrs per week
2. Seminar/ Journal Club/ Group discussions - weekly

Emergency laboratory services:

Emergency hematology including handling automated hematology analysers, preparing peripheral smears, emergency coagulation tests like PT, tests for FDP and D-dimer and fluid counts.

Duration – Usually after working hours and on Sundays and Holidays, in rotation. Maximum duty hours will be 8 hours with compensatory off, as per rules. The duties will be approximately once or twice a month.

SYLLABUS

FIRST YEAR:

Paper I - Basic Haematology and Blood Banking

Haematology – Theory:

1. General aspects of blood cell formation, Sites of haematopoiesis. Development of blood cells. Morphology and Regulation of haematopoiesis
2. Red blood cells - Basic aspects of anemia, definition, pathophysiology, classification and clinical features. Investigation of a case of anemia in general
3. Morphological classification of anemia – role of red cell indices and classification
4. Nutritional deficiency anemias – Iron deficiency anemia, Megaloblastic anemia with emphasis on their laboratory work up
5. Disorders of Hemoglobin, Structure of Hb and Synthesis : Normal and Abnormal hemoglobins, Hemoglobinopathies and Thalassemias
6. Hemolytic anemia: Definition, pathogenesis, classification, clinical features. Laboratory investigations (screening tests) to establish a case of haemolytic anemia. Tests done—
 - a. Peripheral smear - specific morphologic abnormalities
 - b. Reticulocyte count
 - c. Sickling phenomenon
 - d. Kleihauer acid Elution test
 - e. Alkali denaturation test
 - f. Test for G6PD deficiency
7. Leucocyte Disorders—
 - o Leucocytosis – causes
 - o Leukemoid reaction – causes, laboratory tests

Leukemias: Definition, classification - FAB &WHO- classification of acute leukemias, Diagnostic criteria. Cytochemistry of leukemias
9. Automation in Cell counters and ESR
10. Buffy coat preparation –uses and indications
11. Biomedical waste management in hematology

Haematology – Practical:

1. Blood collection and Preparation of blood smear
2. Anticoagulants used in Hematology
3. Cleaning of glassware
4. Manual methods for Hb estimation, WBC, RBC, Platelet and Absolute Eosinophil counts
5. Automation in haematology -demonstration
6. Red cell indices - Baseline interpretation of RBC indices and hemogram charts of automated hematology analyzers for identifying abnormal cases.
7. E.S.R., PCV and buffy coat preparation
8. Stains used in Haematology - preparation of reagents, diluting fluids, preparation of Leishman's stain, Giemsa stain and MGG stain
9. Peripheral smear staining by Leishman's stain with differential count and identifying normal and abnormal smears.
10. Reticulocyte and Hemolysate preparation.
11. Tests for hemolytic anemia -Osmotic fragility test, Acid elution test and Alkali denaturation test for fetal Hb, Sickling test, Hb electrophoresis, Methemoglobin blue reduction test for G6PD deficiency, PNH gel card test, Hams test, sucrose lysis test and HEMPAS
12. Cytochemistry in leukemias: Myeloperoxidase, Sudan Black B, Periodic Acid Schiff, Non-Specific esterase, Chloracetate esterase, Double esterase, Leucocyte alkaline Phosphatase, Acid Phosphatase and Tartrate resistant Acid Phosphatase (TRAP)

Blood Banking

Theory:

1. History of Transfusion Medicine
2. Blood groups systems-ABO and Rh system in details
3. Indications for blood transfusion
4. Blood donation, Donor registration, Donor selection, Blood collection. Adverse donor reaction
5. Anticoagulants used to store blood, Changes occurring in the stored blood
6. Blood grouping -Forward and reverse
7. Coomb's test - Application - DCT, ICT, Rh antibody titre
9. Compatibility testing – Major and Minor cross match

10. Blood components – Indications, preparation of blood components
11. Autologous transfusion
12. Transfusion transmitted disease
13. Hemolytic disease of the new born and exchange transfusion
14. Transfusion reactions and Investigation of transfusion reaction
15. Hemapheresis - Definition, Types of apheresis, Machines and Techniques.
16. Organization of blood bank
17. Biomedical waste management pertaining to blood

Practical:

1. ABO grouping -Forward grouping (slide & tube method), Reverse grouping - preparation of pooled A, B & O cells
2. Rh grouping & Rh typing (slide & tube method), Rh – antibody titration
3. Antiglobulin Testing - Direct and Indirect, Preparation of Coomb's Control Cells.
4. Cross matching Technique - Major, Minor, Saline, albumin, Coomb's
5. Blood Collection [Phlebotomy]
6. Preparation and Storage of blood Components - Packed Cells, Fresh Frozen plasma [FFP] Platelet Concentrate, Cryoprecipitate
7. Investigation of Blood Transfusion reaction
8. Testing for transfusion Transmitted Diseases
 - i. ELISA-HIV, HBsAg, HCV
 - ii. VDRL Test
 - iii. Malaria

Paper II - Basic histopathology, laboratory organization in Pathology

Theory

1. Organisation of Histology Laboratory
2. General introduction to Histological equipment and instruments, their uses, constructions, maintenance and repair.
3. Reception and recording of tissue specimen
4. Biopsy, types of biopsy
5. Fixation and fixatives
6. Collection of specimens – Bits taking
7. Tissue processing and Microtomy including Frozen along with Trouble shooting in these areas
8. Tissue processing – automatic and hand processing, details of the instrument, working of automatic tissue processor
9. Microtomy – different types, use and care of microtome knives, sharpening, cutting, artifacts in cutting, cutting of different tissues, disposable blades
10. Staining – theoretical aspects and practical implications
11. Preparation and quality control of all routine and special stains used in Histopathology
12. Hematoxylin and eosin – counter stains
13. Special stains – stains for nucleic acid, lipid, endogenous pigments, connective tissue, enzymes, amyloid, deposits, fibrin
14. Decalcification
15. Biomedical waste management in histopathology

Practical

1. H and E staining
2. Special staining- carbohydrates, mucins, connective tissue, lipids, pigments, minerals and microorganisms
3. Mounting
4. Tissue processing
5. Sharpening of microtome knives
6. Decalcification

Laboratory organization

1. Basic requirements and functions of a laboratory
2. Purchasing of equipments and chemicals
3. National and international accreditation of laboratories
4. Laboratory safety
5. Blood collection and delivery to different laboratories in a hospital
6. Laboratory statistics
7. Laboratory/Hospital Informatics
8. Laboratory management including financial management

Paper III- Basic Cytology and Clinical pathology

Basic cytology Theory:

1. Basic Structure of mammalian cell
2. Cell Physiology, Cell cycle and cell division
3. Chromosome structure, human chromosome complement and methods of demonstration of sex chromatin
4. Benign Pathological processes affecting the cell
5. General introduction to tumors and morphological characters of cancer cells
6. Normal cervical cytology inflammatory lesion, Infections
7. Effusion cytology including synovial fluid cytology
8. CSF cytology and cell count
9. Introduction to FNAC and guided FNAC
10. Handling of laboratory reagents and equipment
11. Staining techniques in cytology along with relevant special stains
12. Use of cytopsin centrifuge
13. Methods of cell block preparation
14. Biomedical waste management in cytology

Basic cytology Practical:

1. Collection and processing of various cytological samples
2. Preparation and fixation of smears from:
 - a. Effusions
 - b. Sputum
 - c. Bronchial washings
 - d. Urine
 - e. Other body fluids and fluid washing
 - f. Nipple discharge
 - g. FNAC smears
3. Preparation of stains and reagents for routine and special stains in cytology
4. Cytopsin smear preparation for effusion cytology
5. Identification of normal/benign cells in the following samples:
 - a. Cervical and vaginal smears
 - b. Sputum/Bronchial brush smears
 - c. Pleural and peritoneal fluid
 - d. Other fluids and C.S.F
 - e. Urine

6. Identification of sex chromatin
7. methods of Cell block preparation

Clinical Pathology:

Theory:

1. Collection, transport, preservation and processing of various clinical specimens
2. Urine examination, Physical, chemical and microscopic. Manual chemical tests and Urine analysis by Strip method. Automation in urine examination
3. Test for hemosiderin pigment in urine
4. Stool examination Test for Occult blood - Benzidine Test
5. Sputum examination - Collection of specimen i. Physical examination ii. Microscopic - Gram's stain, ZiehlNeelsen stain for AFB iii. Chemical examination. Concentration methods.
6. Cerebrospinal fluid analysis Method of obtaining CSF, indications, contraindications.
7. Examination of CSF: i. Physical examination ii. Biochemical examination iii.
8. Microscopic examination a. Cytological examination b. Bacteriological examination
9. Body fluids Microscopic examination of Pleural, Pericardial, synovial, ascitic and peritoneal fluid.
10. Pregnancy Test- Method, interpretation. Clinical Pathology
11. Semen analysis
12. Synovial fluid analysis

Practical:

1. Urine examination, Physical, chemical and microscopic
2. Manual chemical tests.
3. Urine examination by Strip method.
4. Urine Test for hemosiderin pigment.
5. Stool examination: Benzidine Test- for occult blood
6. Sputum examination: Macroscopic, Microscopic and AFB Staining
7. Examination of Cerebrospinal fluid [CSF] and body fluids with cell count
8. Pregnancy Test
9. Examination of Semen
10. Examination of Synovial fluid

Scheme of Assessment for MSc MLT Pathology I year:

Assessment	Maximum marks
Theory examination	240
Practical and Viva voce examinations (240+20)	260
Internal assessment (Theory - 50 + Practical - 50)	100
Grand total	600

Theory examination:

	Theory papers	Maximum marks
Paper I	Basic Haematology and Blood Banking	80
Paper II	Basic Histopathology and laboratory organisation in pathology	80
Paper III	Basic Cytology and Clinical Pathology	80
Total marks		240

Question pattern will be 10X10 marks for each theory paper with three hours duration.

Practical examinations and viva-voce examinations (One day):

Practical	Maximum marks
Hematology, Histopathology and Cytology	240
Viva-voce	20
Total marks	260

SECOND YEAR

Paper I - Advanced haematology

Theory

1. Disorders of Haemoglobin Structure of Hb and Synthesis : Normal and Abnormal hemoglobins, Hemoglobinopathies and Thalassemias
2. Hemolytic anaemia: Definition, pathogenesis, classification, clinical features. Laboratory investigations (screening and diagnostic) to establish a case of hemolytic anemia. Tests done—
 - a. Peripheral smear - specific morphologic abnormalities
 - b. Osmotic fragility test
 - c. Ham's test, Sucrose lysis Test
 - d. Hb Electrophoresis and HPLC
 - e. Test for G6PD deficiency
3. Bone marrow examination - Aspiration and trephine biopsy, Indications, smear making, processing of trephine biopsies
4. Leucocyte Disorders
 - ✦ Leucocytosis – causes
 - ✦ Leukemoid reaction – causes, laboratory tests
 - ✦ Leukemias: Definition, classification - FAB & WHO- classification of acute leukemias, Diagnostic criteria, Cytochemical staining and Immunophenotyping
 - ✦ Chronic Leukemias: classification, Diagnostic criteria
5. Myeloproliferative disorders - classification, Clinical features, laboratory investigations. Chronic myeloid leukemia in detail
6. Plasma cell disorders - classification. Plasma cell myeloma - definition. Clinical features, laboratory investigations
7. Bleeding disorders:
 - Platelet disorders – Qualitative and Quantitative, Causes and laboratory investigations
 - Coagulation disorders – Inherited and acquired, Laboratory workup.
8. Automation in hematology including coagulation
9. Flow cytometry – Basics, Procedure and application and trouble shooting
10. Organization and quality assurance in hematology – Internal Quality control and external quality assessment programmes
11. Biomedical waste management pertaining to hematology section

Practical:

1. Tests for hemolytic anemia -Osmotic fragility test, Acid elution test and Alkali denaturation test for fetalHb, Sickling test, Hb electrophoresis, HPLC, Methemoglobin blue reduction test for G6PD deficiency, Coomb's test, PNH gel card test, Hams test, sucrose lysis test and HEMPAS
2. Bone marrow smear preparation and staining
3. Cytochemistry in leukemias: Myeloperoxidase, Sudan Black B, Periodic Acid Schiff, Non-Specific esterase, Chloracetate esterase, Double esterase, Leucocyte alkaline Phosphatase, Acid Phosphatase and Tartrate resistant Acid Phosphatase (TRAP)
4. Immunocytochemical Staining in leukemias
5. Principles and applications of flow cytometry
6. Plasma cell Disorders:
 Serum Protein Electrophoresis, Urine Electrophoresis
7. Test of vascular and platelet function:
 Bleeding time, Clot retraction, Platelet count.
 Platelet aggregation studies.
8. Tests for coagulation disorders: Sample collection, pre-analytical variables, anticoagulant, Preparation of PRP, PPP
 Screening tests –
 - First line tests- Prothrombin time (PT) and INR, Activated partial thromboplastin time (APTT), Thrombin time(TT)
 - Second line tests - Mixing studies, Coagulation factor assay, Fibrinogen assay
 - Urea solubility test for Factor XIII
 - Inhibitor screen and principle of inhibitor assay
9. Antiphospholipid Antibody -workup
10. Quality control in the laboratory-preparation of control material, filing of QC charts

Paper II - Advanced Histopathology

Theory:

1. Microscopy – different types of microscopes used in pathology
2. Tissue processing and Microtomy including Frozen along with Trouble shooting in these areas
3. Tissue processing – automatic and hand processing, details of the instrument, working of automatic tissue processor
4. Microtomy – different types, use and care of microtome knives, sharpening, cutting, artifacts in cutting, cutting of different tissues, disposable blades
5. Preparation and quality control of all routine and special stains used in Histopathology
6. Special stains – stains for nucleic acid, lipid, endogenous pigments, connective tissue, enzymes, amyloid, deposits, fibrin
7. Decalcification
8. Tissue of special interest – hard tissue, nervous system, skin, kidney
9. Plastic embedding media and techniques
10. Immunofluorescence (IF)
11. Immunohistochemistry (IHC)
12. Enzyme histochemistry and its applications
13. Electron microscopy – Principle and technical aspects
14. Museum techniques
15. Tissue microarray
16. Automation in Histopathology–
 - a. New generation microtomes, tissue processing, paraffin, Embedding station, stainers and cover slippers.
 - b. Tissue-tek systems, Manual tissue microarray
 - c. Use of microwave oven in processing
17. Automation and recent advances in different disciplines of pathology
18. Organization and quality assurance in histopathology – Internal Quality control and external quality assessment programmes

Practical:

1. Frozen section
2. Special staining- carbohydrates, mucins, connective tissue, lipids, pigments, minerals and microorganisms
3. Immunohistochemistry – Single and double immunostaining, preanalytical variables and trouble shooting
4. Direct and Indirect Immunofluorescence
5. In situ hybridization techniques – CISH, SISH, DDISH, BDISH, FISH (techniques, principles of staining, troubleshooting)
6. Quality control and trouble shooting in Histopathology
7. Biomedical waste management pertaining to histopathology section

Paper III - Advanced Cytology

Theory:

1. General Pathology and Cytology of Tumors
2. Role of cytologic techniques in diagnosis of cancer
3. Pathology and Cytology of Female Genital tract
 - a. Anatomy, embryology, histology, and physiology of Female Genital Tract
 - b. Cytology of female genital tract and normal vaginal flora
 - c. Inflammatory lesions of vagina and cervix
 - d. Cytology of benign disorders of epithelia of uterine cervix and vagina
 - e. Precancerous and cancerous lesions of cervix
 - f. Effect of therapeutic procedure such as radiotherapy and drugs on epithelia of female genital tract
 - g. Significance of cervical cancer screening
 - h. Hormone cytology in various age groups
4. Pathology and Cytology of Respiratory tract, urinary tract with a knowledge of distinguishing between normal and abnormal smears. Identifying malignancies
5. Aspiration biopsy cytology- General principles of technique and cytodiagnosis
6. Methods of cell block preparation
7. Immunocytochemistry on cytology smears
8. Automation in cytology laboratory- Liquid based cytology, Flow cytometry – methods of processing and technical aspects
9. Cytogenetics: Karyotyping and banding techniques
10. Laboratory organization and safety in cytology
11. Setting up of the FNAC laboratory service
12. Organization and quality assurance in Cytology– Internal Quality control and external quality assessment programmes
13. Biomedical waste management pertaining to Cytology section

Practical:

1. Cervical cancer screening:
 - a) Identification of normal, inflammatory metaplastic dysplastic and malignant cells
 - b) Identification of specific infections: Trichomonas vaginalis, Candidiasis, Actinomyces, Herpes genitalis, Condylomatous lesions
 - c) Identification of cells foreign to cervix
2. Hormonal cytology: Calculation of hormonal indices and its interpretation
3. 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 of cell blocks
 - e) Processing of hemorrhagic fluids
4. Identification of benign and malignant cells in the following types of specimens:
 - a) Sputum and bronchial brush cytology
 - b) Effusions
 - c) Oral scrapings
 - d) C.S.F and other body fluids
 - e) Urine
 - f) Nipple discharge
5. Rapid On Site Evaluation : Rapid stains used and methods of staining like toluidine blue, ultrafast PAP etc.

Modules on Molecular Biology and Biostatistics: (included only in formative assessment)

Six classes each for biostatistics and 6 classes each for molecular biology will be held in the second year and internal assessment will be conducted for 20 marks each at the end of the modules. These will be conducted for both students of Microbiology and Pathology together at the same time in the same class.

Molecular biology

1. Essentials of molecular laboratory
2. Nucleic acid extraction methods
3. Probes and designing of primers
4. PCR – Conventional, Multiplex, Nested, Real Time
5. 16s RNA sequencing
6. Next generation sequencing (NGS)
7. Quality control in molecular laboratory

Biostatistics

1. Data and variables: Types of data, tabulation of data
2. Measures of central tendency, measures of dispersion and location
3. Probability: Concepts, laws of probability and probability distribution
4. Sampling, Sampling variability and significance
5. Designing and analysis of lab experiments
6. Correlation and regression analysis concepts
7. Evaluation of diagnostic procedure – Sensitivity, Specificity, Predictive values, Likelihood ratio and ROC curve
8. Testing of hypothesis – concept of hypothesis and statistical significance, Parametric and non-parametric tests.

Suggested Reading: (latest edition)

1. Bain BJ, Bates I, Laffan MA, Lewis SM. Dacie and Lewis Practical Hematology. Philadelphia: Elsevier Churchill Livingstone.
2. McPherson RA, Pincus MR. Henry's Clinical Diagnosis and Management by Laboratory Methods. Philadelphia: Elsevier Saunders.
3. Saxena R, Pati HP, Mahapatra M. de Gruchy's Clinical Hematology in Medical Practice. India: Wiley.
4. Suvarna SK, Layton C, Bancroft JD. Bancroft's Theory and Practice of Histological Techniques. Elsevier Health Sciences.
5. Culling CF, Dunn WL. Handbook of Histopathological and Histochemical Techniques. London: Butterworths.
6. Bibbo M, Wilbur DC. Comprehensive Cytopathology. Elsevier Saunders.
7. Koss LG, Melamed MR. Koss's Diagnostic Cytology, and its Histopathologic Bases. Philadelphia: Lippincott Williams and Wilkins.
8. Nayar R, Wilbur DC. The Bethesda System for Reporting Cervical Cytology. London: Springer.
9. Hoda RS, Hoda SA. Fundamentals of Pap Test Cytology. Humana.
10. Mahajan BK. Methods in Biostatistics. Jaypee.

Scheme of Assessment for MSc MLT Pathology II year:

	Maximum marks
Theory examination	240
Practical, Viva-voce examinations and project (220+20+20)	260
Project	20
Internal assessment (Theory - 50 + Practical - 50)	100
Grand total	600

Theory examination:

	Theory papers	Maximum marks
Paper I	Advanced Haematology	80
Paper II	Advanced Histopathology	80
Paper III	Advanced Cytology	80
Total marks		240

Question pattern will be 10X10 marks for each theory paper with three hours duration.

Practical examinations and viva-voce examinations (One day):

	Maximum marks
Advanced Hematology, Histopathology and Cytology	220
Viva-voce examinations	20
Project work presentation, and viva-voce	20
Total marks	260

Regulations of MSc MLT Pathology course:

Attendance:

- Students are required to attend 75% or more of all theory classes held, and 75% or more of practical/lab postings in each subject to be eligible to appear in the annual examination. Under no condition will a student with less than the prescribed attendance in any subject be allowed to appear in the annual examination of that subject.
- Students with less than 75% attendance in theory and/or practical/lab postings at the end of any year must start afresh in those subjects by joining the junior batch of students. No extra classes will be arranged to make such students eligible for the annual examinations. The attendance accrued in the previous academic year in those subject(s) will not be transferred. Students will be required to secure 75% attendance afresh in theory and practical/clinical of subjects detained, after joining the junior batch to become eligible to appear in the annual examination.
- The 25% leverage in attendance includes all types of leaves (including leave on medical grounds). For absence because of illness or any medical condition, a duly approved medical leave from Dean (Academic) with medical and fitness certificate issued/verified by authorized JIPMER clinical faculty member is mandatory. Certificate must be submitted before or within 10 days after availing medical leave.
- Attendance cannot be improved upon by attending classes during the gap between the annual regular examination and supplementary examination held within 6 weeks of the former.
- Students who are detained in all the subjects of a year due to lack of attendance should join the classes with junior batch within 7 days of declaration of the eligibility/detention list or when classes commence, whichever is earlier.
- Students who are detained in one or more subject(s) because of lack of attendance but are eligible to appear for annual examination in at least one subject of the year should join classes with junior batch within 7 days of completion of the last final theory/practical examination or when classes start, whichever is earlier. Attendance accrued in the previous academic year will lapse and attendance will be calculated afresh from the date of joining the junior batch.
- A show-cause notice will be issued to students on continuous unauthorized absence without prior permission for two weeks or more. If such absence extends to a period more than one month for any reason, the student is liable for termination from the course. The decision of the competent authority is final.
- There is **no condonation permissible** for shortage of attendance.

Internal Assessment (IA):

Comprehensive assessments will be done throughout the course. A minimum of three notified internal assessments (including model examination) will be held for a subject paper periodically in each year before the final annual examination and the candidate will be examined in theory and practical. Each notified test and the model examination will carry equal weightage for calculation of final internal assessment marks. The internal assessment marks will form 20% of the summative assessment. However, there is no minimum cut-off percentage of internal assessment mandatory to become eligible to appear in the annual examination.

Project:

1. Submission of project work is mandatory for the appearing in the final examination. The project work shall be carried out by the candidate under the guidance of a postgraduate teacher in the department. No change in the project work topic/Guide shall be made without prior approval from the Institute. The topics for the project shall be selected within the first three months of the course and complete the project work, after approval of Departmental postgraduate monitoring committee and Institute Ethics committee, as per institute guidelines. The final project shall be submitted three months before the final examination. The project work is mainly to orient the candidate towards research methodology. Collaboration works with other departments are encouraged.
2. The project will be sent for review by an external faculty and will be evaluated by the External/Internal Examiners at the time of viva voce examination of the candidate during the final summative exam. 20 marks will be allotted for the quality of work and defending of the project by the candidate.
3. The final project duly approved by the external/ Internal Examiners will be submitted to the Dean's office along with the result. The Dean's office will send the project to the library for record.

Logbook:

All the candidates shall maintain a Logbook for recording performance of activities, seminars, journal Club and other presentations. The Logbook verified by the course coordinator/concerned faculty in-charge shall be certified by the Head of the Department and presented in the Final Practical Examination.

Examination rules and regulations:

1. A student needs to pass in all theory paper(s) and practical examination in the I year to progress to the II year.
2. In the I and II years, If the candidate fails to pass in the practical examination, he/she will be required to appear in all the theory papers and the practical in the supplementary examination. If the candidate passes in the practical examination but fails only in one or two theory papers, he/she will be permitted to appear only for that theory paper(s) in the supplementary exam, provided he/she has 50% or above (consolidated) in theory papers. If the candidate passes in the practical examination but fails in three or four theory papers, he/she will be required to appear in all the theory papers and the complete practical examination in the supplementary examination.
3. In case of fail result in any theory subject and/or practical in the 2nd attempt (supplementary examination), the student will study with the next junior year's batch and will have to reappear for Year 1/ Year 2 examination again the next year (3rd attempt). A student failing in any one or more theory subject(s) and/or practical examination in this attempt will reappear in a supplementary examination (to be held within 6 weeks) in the particular subjects (4th attempt).
4. If a student fails even in the 4th attempt, no further chances will be given, and his/her name will be struck off the rolls of JIPMER.
5. A student needs to complete the entire 2-year course within 4 years from the date of enrolment (twice the duration of the course), beyond which he/she will not be allowed to appear in any examination. Any exception for extenuating reasons (e.g. prolonged illness of the candidate, family problems, natural calamities, etc.) will be made only after approval of the Academic Advisory Committee and Head of the institution.
6. No grace marks will be awarded for either theory or practical examinations, under any circumstances.

Pass criteria:

1. A minimum 40% in each of the theory paper and overall aggregate, in theory (all papers put together) should obtain a minimum of 50% marks.
2. A minimum of 50% in practical separately.
3. A minimum of 50% of the grand total (theory, practical, project and internal assessments).

MODEL QUESTION PAPER
MSc MLT PATHOLOGY FIRST YEAR EXAMINATION
PAPER I

Basic Hematology and Blood Banking

Time: 3 hours

Maximum Marks: 80

Answer all the questions.

Each question carries TEN marks.

1. Describe different morphologic patterns of anaemia and enlist the causes for microcytic hypochromic anaemia. Add a note on the laboratory workup of Iron deficiency anaemia. (3+3+4)
2. Define hemoglobinopathy. Discuss the genetic defect in Sickle cell anaemia and its laboratory workup in detail. (2+3+5)
3. Define haemolytic anaemia. Describe in detail the classification and laboratory workup of haemolytic anaemia. (2+3+5)
4. What is a reticulocyte? What are the stains used for demonstration of reticulocytes? How does it help in anaemia work up. (2+ 4+4)
5. Discuss in detail about automation in cell counters and in ESR. (7+3)
6. What is Landsteiner's law? Mention the important blood group systems. Add a note on methods of blood group typing. (3+3+4)
7. What are the transfusion related diseases? Enlist the laboratory investigations done in Blood bank to prevent transfusion related diseases. (3+7)
8. What all anticoagulants are used in blood bank for storing blood? Discuss the various blood components prepared in a Blood Bank and their uses. (3+7)

MODEL QUESTION PAPER
MSc MLT PATHOLOGY FIRST YEAR EXAMINATION
PAPER II

Basic Histopathology and Laboratory organization in Pathology

Time: 3 hours

Maximum Marks: 80

Answer all the questions.

Each question carries TEN marks.

1. Define fixation. What are the properties of an ideal fixative and how are fixatives classified? (2+3+5)
2. Enumerate the different microtomes with notes on their specific uses in Histopathology. Discuss in detail the artefacts in microtomy sections. (5+5)
3. Discuss the preparation and storage of Hematoxylin and Eosin stain. Add a note on trouble shooting in H&E stain. (5+5)
4. Discuss the different stains used for demonstrating micro-organisms. (10)
5. Name the special stains for demonstration of mucin. What is the principle of Mucicarmine stain? What is importance of pH in mucin stains? (3+3+4)
6. What are the various endogenous pigments in humans? Discuss in detail the special stains used for demonstrating these endogenous pigments. (3+7)
7. Discuss in detail the working of an automated tissue processor and add a note on the advantages and disadvantages of automatic tissue processing. (6+2+2)
8. Discuss in detail about laboratory safety at different levels in histopathology. (10)

MODEL QUESTION PAPER
MSc MLT PATHOLOGY FIRST YEAR EXAMINATION
PAPER III

Basic Cytology and Clinical Pathology

Time: 3 hours

Maximum Marks: 80

Answer all the questions.
Each question carries TEN marks.

1. Draw and label a normal human chromosome. Describe the normal human karyotype. Elaborate on the various methods of demonstrating sex chromatin. (2+3+5)
2. Discuss the fixatives used in Cytology. Add a note on coating fixatives. (5+5)
3. Describe in detail the role of cytospin centrifuge in a cytology laboratory. (10)
4. Discuss the principle, preparation, procedure, and utility of PAS stain in cytology practice. (2+3+2+3)
5. Describe the handling of *mucoïd* specimens and *bloody* fluid samples highlighting the contrast with handling of clear, low protein fluids. (5+5)
6. Discuss the cytological aspects of various infective conditions that can be detected in vaginal smear. (10)
7. Discuss in detail the handling and processing of CSF sample. Add a note on CSF cell counting. (7+3)
8. What are the methods of fine needle aspiration. Discuss troubleshooting in Pap stain. Add a note on Diff Quik stain. (2+6+2)

MODEL QUESTION PAPER
MSc MLT PATHOLOGY SECOND YEAR EXAMINATION
PAPER I

Advanced Hematology

Time: 3 hours

Maximum Marks: 80

Answer all the questions.

Each question carries TEN marks.

1. Enumerate the indications of Bone marrow examination. What are the various needles used to obtain bone marrow samples. Add a note on processing of bone marrow biopsy. (4+3+3)
2. Define Acute Leukemia. Discuss the utility of various cytochemical stains in the workup of Acute Leukemias. (2+8)
3. Discuss the presentation, peripheral smear picture and cytogenetic anomaly in Chronic Myeloid Leukemia (CML). Add a note on the utility of LAP score in the diagnosis of CML. (6+4)
4. Enumerate the various laboratory tests used in the diagnosis of Multiple Myeloma. Write in detail on the role of serum Electrophoresis in such patients. (4+6)
5. Discuss the coagulation pathways involved in clotting of blood. Add a note on the base line coagulation tests. (5+5)
6. What is the principle of Flow cytometry. Discuss sample preparation with emphasis on the various fluorophores used in Leukemia diagnosis in flow cytometry. (3+7)
7. What is the principle of Platelet aggregometry. Explain in detail the collection and processing of patient sample and preparation of reagents used in Aggregometer. (2+8)
8. What is Quality control. Enumerate few common pre-analytical and post-analytical variables in processing samples received for routine workup. Discuss the utility of Levey Jennings plot in hematology laboratory. (2+6+2)

MODEL QUESTION PAPER
MSc MLT PATHOLOGY SECOND YEAR EXAMINATION
PAPER II

Advanced Histopathology

Time: 3 hours

Maximum Marks: 80

Answer all the questions.

Each question carries TEN marks.

1. Discuss plastic embedding media and their application in histopathology. (10)
2. Discuss the principle of Fluorescence microscopy. Discuss the pre-analytical variables affecting processing on renal biopsies for Immunofluorescence. (4+6)
3. Discuss the various techniques and enzyme systems available for performing Immunohistochemistry. (10)
4. Elaborate on the methods of extraction of cellular antigens for IHC. (10)
5. Elaborate, in detail, the processing of a Lung cancer specimen to be mounted for display in Pathology Museum. What are the advantages of Perspex in museum science? (8+2)
6. What is Tissue Microarray. Describe the steps of preparation of a Tissue microarray highlighting the differences with conventional tissue processing. Add a note on the utility of Tissue Microarray. (2+6+2)
7. Discuss in detail Microwave processing highlighting the advantages over conventional Tissue processing. (10)
8. Write short notes on: (5+5)
 - a. Stains for amyloid
 - b. Metachromatic dyes

MODEL QUESTION PAPER
MSc MLT PATHOLOGY SECOND YEAR EXAMINATION
PAPER III
Advanced Cytopathology

Time: 3 hours

Maximum Marks: 80

Answer all the questions.

Each question carries TEN marks.

1. Discuss the cytomorphology of normal and reactive squamous cells in contrast to Squamous cell carcinoma. (10)
2. Elaborate on banding techniques in cytogenetic analysis. (10)
3. Explain the various methods used to prepare cell block from cytology samples. Enumerate the advantages of cell block preparation over aspirate smears. (6+4)
4. Elaborate on the processing of urine samples. Discuss automation in urine cytology. (5+5)
5. Discuss the various steps in performing immunocytochemistry and highlight the differences with immunohistochemistry. Add a note on Multiplex immunohistochemistry. (8+2)
6. Compare and contrast Sure Path and Thin Prep. Enumerate the advantages of Liquid based cytology over conventional Pap smear processing. (6+4)
7. What are the requirements in setting up a FNAC laboratory? Discuss the measures to be undertaken to ensure safe laboratory practice. (6+4)
8. What is Quality Assurance? Elaborate on the various quality control measures being practiced in our cytology laboratory. (2+8)
