सत्यमेव जयते

National Commission for Allied and Healthcare Professions

(NCAHP)

Competency Based Curriculum

for

Diploma

in

MEDICAL LABORATORY TECHNOLOGY

DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY

DMLT

KNOWLEDGE • SKILL • COMPASSION

As per NCAHP Act 2021

NATIONAL COMMISSION FOR ALLIED AND HEALTHCARE PROFESSIONS
स्वास्थ्यम् सर्वार्थसाधनम्
NCAHP
Since-2021

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CHAPTER 1
Introduction

1.1. Program Overview

The **Diploma in Medical Laboratory Technology (DMLT)** is a **competency-based, skill-oriented program** designed in alignment with the standards prescribed by the National Commission for Allied and Healthcare Professions.

The program prepares learners to function as **Medical Laboratory Associates** by developing competencies in **pre-analytical, analytical, and post-analytical phases** of diagnostic laboratory services.

The curriculum integrates **knowledge, skills, values, and attitudes (KSVA)** required to support clinicians in **diagnosis, treatment monitoring, and disease prevention**.

1.2. Professional Role Definition

A Medical Laboratory Associate (DMLT graduate) is a healthcare professional who:

- Performs routine diagnostic laboratory tests under supervision
- Ensures accuracy and reliability of laboratory results
- Maintains laboratory equipment and consumables
- Adheres to **biosafety, infection control, and quality standards**
- Supports patient care through timely and accurate reporting

1.3. Competency Domains

The curriculum is structured across the following **core competency domains**:

A. Domain 1: Professional Knowledge (Cognitive Domain)

The learner shall be able to:

- Describe basic concepts of:
  - Human Anatomy & Physiology
  - Pathology and disease processes
  - Clinical Biochemistry
  - Microbiology and Immunology
  - Haematology and Blood Banking
- Explain principles of laboratory investigations and diagnostic techniques
- Understand **reference ranges, normal values, and basic interpretation of results**

B. Domain 2: Technical and Procedural Skills (Psychomotor Domain)

The learner shall demonstrate the ability to:

Pre-Analytical Competencies

- Perform patient identification and sample collection (phlebotomy basics)
- Ensure correct labeling, transport, and storage of specimens
- Apply criteria for **sample acceptance/rejection**

Analytical Competencies

- Perform routine laboratory investigations in:
  - Haematology (Hb, TLC, DLC, ESR, etc.)
  - Biochemistry (glucose, urea, creatinine, etc.)
  - Microbiology (smear preparation, staining, culture basics)
  - Blood grouping and cross-matching
- Operate, calibrate, and maintain laboratory equipment
- Follow **standard operating procedures (SOPs)**

Post-Analytical Competencies

- Record, validate, and report results accurately
- Maintain laboratory records and documentation
- Communicate critical values to supervisors

C. Domain 3: Professional Skills & Ethics (Affective Domain)

The learner shall:

- Demonstrate **professional integrity, accountability, and ethical practice**
- Maintain **patient confidentiality and data privacy**
- Exhibit respect, empathy, and sensitivity in patient interactions
- Work effectively as part of a **multidisciplinary healthcare team**

D. Domain 4: Communication Skills

The learner shall be able to:

- Communicate effectively with:
  - Patients (during sample collection)
  - Clinicians and laboratory supervisors
- Maintain clear and accurate documentation
- Use appropriate medical terminology in reporting

E. Domain 5: Patient Safety & Quality Assurance

The learner shall:

- Follow **biosafety guidelines and infection control practices**
- Implement **quality control (QC) and quality assurance (QA)** measures
- Participate in internal and external quality programs
- Practice **biomedical waste management** as per regulations

F. Domain 6: Lifelong Learning & Professional Development

The learner shall:

- Demonstrate ability for **self-directed learning**
- Adapt to new technologies and laboratory advancements
- Engage in continuous professional development

1.4. Program Objectives (Mapped to Competencies)

The program aims to:

- Develop **competency in routine laboratory diagnostic procedures** (Domain 2)
- Build strong **foundational knowledge base** (Domain 1)
- Promote **ethical, safe, and quality-driven practices** (Domains 3 & 5)
- Enhance **communication and teamwork skills** (Domain 4)
- Prepare learners for **entry-level employment and career progression** (Domain 6)

1.5. Training Outcomes (Competency-Based)

On completion, the graduate will be able to:

- Perform laboratory procedures across all phases (pre, analytical, post)
- Ensure adherence to **quality standards and safety protocols**
- Assist in laboratory management and inventory control
- Demonstrate professionalism and effective communication
- Function efficiently as a **Medical Laboratory Associate**

1.6. Eligibility Criteria

- 10+2 (Physics, Chemistry, Biology) from a recognized board
- Minimum age: 17 years
- Merit-based admission
- Eligibility of foreign qualifications as per the Association of Indian Universities
- Mandatory medical fitness certificate

1.7. Program Structure

- **Duration:** 2 Years
- **Qualification:** Diploma in Medical Laboratory Technology (DMLT)
- **Medium:** English

1.8. DMLT Program – Approved Student Intake

Intake Capacity

- **Minimum Intake:** 30 students per batch
- **Maximum Intake:** 60 students per batch

✓ Intake should be sanctioned based on **available infrastructure, faculty, and clinical facilities**

1.9. Core Subjects (Competency-Mapped)

Subject	Competency Domain Mapping
Anatomy & Physiology	Domain 1
Biochemistry	Domains 1, 2
Pathology	Domains 1, 2
Microbiology	Domains 1, 2
Haematology	Domains 1, 2
Immunology & Serology	Domains 1, 2
Blood Banking & Phlebotomy	Domains 2, 3, 5
Histopathology & Cytology	Domains 1, 2
Quality Assurance	Domain 5

1.10. Career Pathways (NCAHP-Aligned Role Exit)

Graduates are eligible for roles such as:

- Medical Laboratory Associate
- Laboratory Technician / Assistant
- Phlebotomy Technician

Employment sectors include:

- Hospitals and diagnostic laboratories
- Blood banks
- Public health laboratories
- Research and pharmaceutical industries

1.11. Academic Progression

Eligible candidates may pursue:

- **Bachelor of Medical Laboratory Science (BMLS)** (with lateral entry provisions as per NCAHP norms)

1.12. Curriculum Review

The curriculum shall be reviewed every **four years** in alignment with evolving standards of the National Commission for Allied and Healthcare Professions to ensure relevance, quality, and industry alignment.

CHAPTER 2
Minimum Standard Requirements

2.1 Infrastructure Requirement

For a **Diploma in Medical Laboratory Technology (DMLT)** program, departments are structured to ensure coverage of all **core diagnostic laboratory services** as expected by the National Commission for Allied and Healthcare Professions. These departments support **competency-based training across pre-analytical, analytical, and post-analytical phases**.

Core Departments Required for DMLT

1. Haematology Department

- Focus: Study of blood and related disorders
- Key Functions:
  - Complete blood counts (CBC)
  - Peripheral smear examination
  - ESR, PCV
- Role in training:
  - Cell morphology
  - Manual and automated blood analysis

2. Clinical Biochemistry Department

- Focus: Chemical analysis of body fluids
- Key Functions:
  - Blood glucose, urea, creatinine
  - Liver and kidney function tests
- Role in training:
  - Instrument-based diagnostics
  - Quantitative analysis

3. Microbiology Department

- Focus: Detection of infectious agents
- Key Functions:
  - Culture and sensitivity
  - Staining techniques (Gram, ZN)
- Role in training:
  - Aseptic techniques
  - Microbial identification

4. Clinical Pathology Department

- Focus: Routine examination of body fluids
- Key Functions:
  - Urine analysis
  - Stool examination
  - Body fluid analysis
- Role in training:
  - Microscopy and basic diagnostics

5. Histopathology & Cytology Department

- Focus: Study of tissues and cells
- Key Functions:
  - Tissue processing and staining
  - Cytology smear examination
- Role in training:
  - Morphological diagnosis
  - Slide preparation and interpretation

6. Blood Banking / Immunohematology Department

- Focus: Safe blood transfusion services
- Key Functions:
  - Blood grouping (ABO, Rh)
  - Cross-matching
  - Blood storage
- Role in training:
  - Transfusion safety
  - Compatibility testing

Support / Ancillary Units (Highly Recommended)

7. Phlebotomy & Sample Collection Unit

- Sample collection and handling
- Pre-analytical error control

8. Central Laboratory / Common Instrumentation Facility

- Shared equipment:
  - Centrifuges
  - Refrigerators
  - Balances
- Supports all departments

9. Quality Assurance & Laboratory Management Unit

- SOPs and documentation
- Internal quality control
- Accreditation readiness

10. Biosafety & Waste Management Area

- Infection control practices
- Biomedical waste disposal

Minimum Essential vs Recommended Structure

Essential (Mandatory for DMLT)

- ✓ Haematology
- ✓ Biochemistry
- ✓ Microbiology
- ✓ Clinical Pathology
- ✓ Blood Bank
- ✓ Histopathology & Cytology

Recommended (For Better Training & Accreditation)

- ✓ Phlebotomy unit
- ✓ Central instrumentation
- ✓ QA & safety unit

11. Laboratory Capacity

Intake	Requirement
30 students	Standard single lab per department
60 students	Larger labs or batch-wise division

Must ensure:

- **Microscope ratio:** 1 per 3 students
- Adequate workbench space
- Functional equipment for simultaneous use

Classroom Requirement

- Seating for full batch (60 max)
- AV aids (projector, screen)

12. Clinical Facility Requirements for DMLT

(Aligned with expectations of the National Commission for Allied and Healthcare Professions)

1. Purpose of Clinical Facility

Clinical facilities must enable students to:

- Gain **hands-on experience in real diagnostic settings**
- Perform procedures across:
  - Pre-analytical
  - Analytical
  - Post-analytical phases
- Develop **competency-based laboratory skills**

2. Types of Acceptable Clinical Facilities

An institution must have:

A. Own Teaching Hospital (Preferred)

OR

B. Affiliated / Attached Facility

- NABL-accredited diagnostic laboratory *(preferred)*
- Recognized hospital laboratory

✓ Formal **MoU/Agreement is mandatory**

3. Minimum Clinical Departments Required

The clinical facility must include:

- Haematology
- Clinical Biochemistry
- Microbiology
- Blood Bank / Immunohematology
- Clinical Pathology
- Histopathology & Cytology *(desirable but strongly recommended)*

✓ All departments must be **functional**

4. Patient Load / Sample Load (Critical Requirement)

The facility must demonstrate **adequate daily workload**:

Department	Minimum Expected Activity
Biochemistry	Routine tests (glucose, LFT, RFT) daily
Haematology	CBC, smear preparation
Microbiology	Sample processing + staining
Blood Bank	Regular grouping & cross-match
Pathology	Urine/stool examination

✓ Students must have **real sample exposure (not simulated only)**

2.2 Library and Learning Resources

1. Textbooks (Core Requirement)

Minimum Titles per Subject

- At least **3–5 different titles per core subject**

Core Subjects Covered

- Anatomy & Physiology
- Biochemistry
- Microbiology
- Haematology
- Pathology
- Immunology & Blood Banking
- Histopathology & Cytology
- Quality Assurance

Minimum Copies (Very Important)

Student Intake	Copies per Core Textbook
30 students	10–12 copies
60 students	15–20 copies

✓ At least **1 copy per 3–5 students**

Total Minimum Books

- **Titles:** 25–40 books
- **Total copies:** 150–300 books

2. Reference Books

- Minimum **2–3 reference books per subject**
- Advanced/standard texts (faculty + top students use)

✓ Total: **15–25 reference books**

3. Practical Manuals

- At least **1–2 practical manuals per subject**

✓ Copies:

- **1 per 2–3 students**

✓ Total: **60–120 manuals**

4. Journals (Print / Online)

Minimum Requirement

- **3–5 relevant journals**

Suggested Areas

- Clinical pathology
- Microbiology
- Laboratory medicine
- Hematology

✓ Prefer **online access (cost-effective + updated)**

5. E-Resources (Highly Recommended)

- Access to:
  - E-books
  - Online journals
  - Digital atlases
  - Video demonstrations

✓ At least **1 institutional subscription**

6. Teaching–Learning Resources

Mandatory

- Charts and posters (lab techniques, safety)
- Models (microscope, blood cells, tissues)
- Slide sets (histology/cytology)
- SOP manuals

Digital Tools

- PowerPoint lecture repository
- Virtual microscopy (if available)
- Skill demonstration videos

7. Library Infrastructure

- Seating capacity: **at least 25–30% of student intake**
- Separate:
  - Reading area
  - Reference section
- Computer with internet access

2.3 Laboratory

1. Overall Laboratory Infrastructure

Space & Layout

- Separate functional labs for each core department
- **Minimum area per lab:** 500–800 sq ft (scaled to intake)
- Adequate lighting, ventilation, water, drainage
- Non-porous, chemical-resistant workbenches

Student Capacity

- Designed for **20–30 students per batch**
- Clear demarcation of:
  - Demonstration area
  - Student work area
  - Equipment zone

2. Common Essential Facilities (All Labs)

Equipment

- Binocular microscopes (1 per 3–4 students)
- Centrifuge (bench-top)
- Refrigerator (2–8°C)
- Deep freezer (−20°C)
- Analytical balance
- pH meter
- Water bath
- Incubator
- Distilled water unit

Safety & Compliance

- Fire extinguisher
- Eye wash station
- First aid kit
- PPE (gloves, masks, lab coats)
- Biomedical waste bins (color-coded)
- Spill management kit

Documentation

- Standard Operating Procedures (SOPs)
- Equipment maintenance & calibration logs
- Quality control (QC) records

3. Department-wise Minimum Laboratory Requirements

A. Haematology Laboratory

Space: ~600 sq ft

Essential Equipment

- Microscopes
- Hemoglobinometer
- Hemocytometer (Neubauer chamber)
- ESR apparatus
- Microhematocrit centrifuge
- Automated hematology analyzer *(desirable)*

Functional Areas

- Smear preparation
- Staining area

B. Clinical Biochemistry Laboratory

Space: ~600–800 sq ft

Essential Equipment

- Colorimeter
- Semi-auto biochemistry analyzer
- Spectrophotometer *(desirable)*
- Micropipettes
- Centrifuge

Functional Areas

- Reagent preparation
- Instrumentation section

C. Microbiology Laboratory

Space: ~700–900 sq ft

Essential Equipment

- Biosafety cabinet / laminar airflow
- Incubator
- Autoclave
- Hot air oven
- Microscope

Functional Areas

- Media preparation
- Culture handling
- Sterilization area *(mandatory separation)*

D. Clinical Pathology Laboratory

Space: ~400–500 sq ft

Essential Equipment

- Microscope
- Centrifuge
- Urine analysis kits/strips
- Glassware

E. Histopathology & Cytology Laboratory

Space: ~500–700 sq ft

Essential Equipment

- Microtome
- Tissue processor *(desirable)*
- Water bath
- Staining setup (H&E)
- Microscopes

Functional Areas

- Tissue processing
- Section cutting
- Slide storage

F. Blood Banking / Immunohematology

Space: ~500–700 sq ft

Essential Equipment

- Blood bank refrigerator (2–6°C)
- Serological centrifuge
- Antisera (Anti-A, Anti-B, Anti-D)
- Water bath (37°C)

Functional Areas

- Blood grouping
- Storage

G. Phlebotomy & Sample Collection Area

Space: 200–300 sq ft

Essential Equipment

- Phlebotomy chair
- Vacutainer system
- Tourniquets
- Sharps disposal containers

4. Support Areas (Mandatory)

- Preparation room
- Washing/cleaning area
- Reagent/chemical store
- Faculty room
- Demonstration/classroom space

5. Student–Equipment Ratio

- Microscope: **1 per 3 students**
- Pipettes: **1 per 2–3 students**
- Major instruments: shared but **functional and sufficient**

6. Quality & Safety Requirements

Must demonstrate:

✓ Internal Quality Control (IQC)
✓ Equipment calibration records
✓ Biosafety practices
✓ Biomedical waste management compliance

7. Minimum Functional Capability

Each lab must be able to **actually perform routine tests**, not just display equipment:

- Haematology → Hb, TLC, DLC, ESR
- Biochemistry → glucose, urea
- Microbiology → staining, basic culture
- Blood Bank → grouping, cross-match
- Histopathology → H&E staining

8. Laboratory Capacity

Intake	Requirement
30 students	Standard single lab per department
60 students	Larger labs or batch-wise division

✓ Must ensure:

- **Microscope ratio:** 1 per 3 students
- Adequate workbench space
- Functional equipment for simultaneous use

2.4 Faculty

1. Guiding Principles (NCAHP Framework)

Faculty deployment must ensure:

- Adequate student–teacher ratio for competency-based training
- Availability of qualified, domain-specific faculty across laboratory disciplines
- Integration of theory + practical + clinical training supervision
- Faculty capable of delivering competency-based education (CBE), OSCE, and workplace-based assessments

2. Student–Faculty Ratio

- Recommended Ratio: 1 : 15 (Teacher : Students)
- For practical/lab sessions: 1 : 10 (mandatory for skill-based training) to ensure effective supervision during:
- Phlebotomy
- Sample processing
- Instrument handling
- OSCE assessments

3. Faculty Designation Structure

A. Programme Head / Course Coordinator

- Qualification:
  - MSc Medical Laboratory Science / Microbiology / Biochemistry / Pathology or equivalent
- Experience:
  - Minimum 5 years teaching/clinical experience
- Role:
  - Academic leadership
  - Curriculum implementation (NCAHP compliance)
  - Coordination of assessments and clinical postings

B. Tutors / Lecturers

- Qualification:
  - BMLS / MSc MLT / relevant life sciences discipline
- Experience:
  - 0–3 years (freshers acceptable with supervision)
- Role:
  - Theory teaching
  - Practical demonstrations
  - OSCE facilitation
  - Logbook verification

C. Senior Faculty / Assistant Professor Level (Desirable for Larger Intake)

- Qualification: MSc / PhD (relevant discipline)
- Experience: 3–5 years
- Role:
  - Advanced teaching
  - Research integration
  - Quality assurance oversight

D. Laboratory Instructors / Technical Staff

- Qualification:
  - DMLT / BMLT
- Role:
  - Assist in practical sessions
  - Maintain equipment and reagents
  - Ensure lab readiness

4. Discipline-wise Faculty Distribution

Minimum faculty must cover:

- Haematology
- Clinical Biochemistry
- Microbiology
- Blood Banking / Immunohematology
- Pathology & Histopathology

✓ Cross-qualified faculty may teach multiple subjects in smaller institutions.

5. Minimum Faculty Requirement (Suggested Model)

For Intake: 30 Students

Position	Number
Programme Head	1
Tutors/Lecturers	2–3
Lab Instructor/Technician	1–2

For Intake: 60 Students

Position	Number
Programme Head	1
Senior Faculty	1
Tutors/Lecturers	3–5
Lab Instructor/Technician	2–3

6. Faculty Responsibilities

Faculty must:

- Deliver competency-based teaching
- Conduct:
  - OSCE/OSPE
  - Practical exams
  - Viva voce
- Maintain:
  - Student logbooks
  - Skill competency records
- Supervise:
  - Clinical postings
  - Laboratory work
- Ensure:
  - Adherence to biosafety and QA protocols
- Participate in:
  - Curriculum review
  - Academic audits

7. Faculty Development Requirements

Institutions must ensure faculty are trained in:

- Competency-Based Medical Education (CBME)
- OSCE/OSPE design and evaluation
- Quality assurance in laboratory services
- Biomedical waste management
- Use of modern diagnostic instruments

8. Visiting / Adjunct Faculty (Recommended)

To strengthen program quality:

- Pathologists
- Microbiologists
- Biochemists
- Blood bank specialists

From:

- Hospitals
- NABL-accredited labs
- Medical colleges

CHAPTER 3
Curriculum

3.1 CURRICULUM OUTLINE

DMLT FIRST SEMESTER

Course Name	Lecture	Tutorial	Practical	Credits	Contact Hours
Introduction to Medical Laboratory Science	2		0	2	30
Communication, Professionalism and Ethics	1	1	0	2	30
Basic Emergency Care and First Aid	1	1	0	2	30
Basics of Medical Terminology	1	1	0	2	30
Basics of Human Anatomy and Physiology	3	1	0	4	60
Clinical Chemistry and Instrumentation	3	1	0	4	60
Human Anatomy and Physiology Practicals	0	0	2	2	60
Clinical Applications 1 (Clinical Chemistry)	0	0	2	2	90
Total	**11**	**5**	**4**	**20**	**390**

DMLT SECOND SEMESTER

Course Name	Lecture	Tutorial	Practical	Credits	Contact Hours
Introduction to Medical Microbiology	3	1	0	4	60
Urine and Body Fluids Analysis	3	1	0	4	60
Introduction to Hematology	2	1	0	3	45
Basics of Blood Banking	2	1	0	3	45
Microbiology Practicals	0	0	2	2	60
Urine and Body Fluids Practicals		0	2	2	60
Clinical Applications 2 (Phlebotomy, Haematology and Blood banking)	0	0	2	2	90
Total	**10**	**4**	**6**	**20**	**420**

DMLT THIRD SEMESTER

Course Name	Lecture	Tutorial	Practical	Credits	Contact Hours
Histopathology and Cytology	3	1	0	4	60
Applications of Microbiology	2	1	0	3	45
Applications of Hematology	2	1	0	3	45
Advanced skills in Blood Banking	3	1	0	4	60
Histopathology and Cytology Practicals	0	0	0	2	60
Hematology Practicals	0	0	2	2	60
Clinical Applications 3 (Microbiology)	0	0	2	2	90
Total	**10**	**4**	**4**	**20**	**420**

DMLT FOURTH SEMESTER

Course Name	Lecture	Tutorial	Practical	Credits	Contact Hours
Clinical Lab Rotation 1 - Clinical Chemistry			0	5	225 hours
Clinical Lab Rotation 2- Microbiology			0	5	225 hours
Clinical Lb Rotation 3- Hematology and Blood Bank		0	0	5	225 hours
Clinical Lab Rotation 4- Histopathology and Cytology		0	0	5	225 hours
Total				**20**	**900**

Total credits **= 20 X 4= 80 credits**
Total Contact hours **= 390+420+420+900 = 2130**
Contact hours of all semesters **= (Theory = 660 hrs + Practicals 1470 Hrs)**

Credit Details:

- **Lecture / Tutorial: 1 credit = 15 hours**
- **Practical: 1 credit = 30 hours**
- **Clinical Lab postings: 1 credit = 45 hours**

Credit Includes: L – Lectures, T - Tutorials, P - Practical.

3.2 MARKS DISTRIBUTION

DMLT FIRST SEMESTER

Course Name	Continuous Assessment	End Semester Examination	Total
Introduction to Medical Laboratory Science	15	35	50
Communication, Professionalism and Ethics	15	35	50
Basic Emergency Care and First Aid	15	35	50
Basics of Medical Terminology	15	35	50
Basics of Human Anatomy and Physiology	30	70	100
Clinical Chemistry and Instrumentation	30	70	100
Human Anatomy and Physiology Practicals	15	35	50
Clinical Applications 1 (Clinical Chemistry)	15	35	50
Total			**500**

DMLT SECOND SEMESTER

Course Name	Continuous Assessment	End Semester Examination	Total
Introduction to Medical Microbiology	30	70	100
Urine and Body Fluids Analysis	30	70	100
Introduction to Hematology	30	70	100
Basics of Blood Banking	30	70	100
Microbiology Practicals	15	35	50
Urine and Body Fluids Practicals	15	35	50
Clinical Applications 2 (Phlebotomy, Hepatology and Blood banking)	15	35	50
Total			**550**

DMLT THIRD SEMESTER

Course Name	Continuous assessment	End Semester Examination	Total
Histopathology and Cytology	30	70	100
Applications of Microbiology	30	70	100
Applications of Hematology	30	70	100
Advanced skills in Blood Banking	30	70	100
Histopathology and Cytology Practicals	15	35	50
Hematology Practicals	15	35	50
Clinical Applications 3 (Microbiology)	15	35	50
Total			**550**

DMLT FOURTH SEMESTER

Course Name	Continuous assessment	End Semester Examination	Total
Clinical Lab Rotation 1 - Clinical Chemistry	50	50	100
Clinical Lab Rotation 2- Microbiology	50	50	100
Clinical Lab Rotation 3- Haematology and Blood Bank	50	50	100
Clinical Lab Rotation 4- Histopathology and Cytology	50	50	100
Total			**400**

Credit Distribution:
Each semester would consist of a minimum of 20 credits. The credit distribution hours for Lecture, Tutorial, Practical, and Clinics are as follows:

Credit Details:
Lecture / Tutorial: 1 credit = 15 hours; Practical: 1 credit = 30 hours; Clinical/ Lab Posting: 1 credit = 45 hours
Credit Includes: L – Lectures, T- Tutorials, P- Practical
Diploma Program Requirements: A minimum of 80 credits is required for the DMLT
A program of 2 years duration, inclusive of six months clinical lab posting

Promotion Criteria to higher semesters:
The eligibility for promotion to the next academic year is subject to securing the minimum academic performance as specified below

- First to second year: a minimum of 70% of the credits at the end of the first year (includes first and second semester)

The student must complete all the coursework requirements within a maximum of double the program duration. For example, in a 2-year program, all the academic coursework needs to be completed within 4 years. Failure to do so will result in exit from the program.

Weightage distribution

Item	**Weightage (%)**
Formative	
Class participation/presentation	5%
Assignment & quizzes	10%
Sessional exams	15%
Summative	
End-of-Semester University exam	70%
Total	100 %

- Any components/ activities that need to be evaluated as part of the internship, without reflecting them in the CGPA

Point grading system (credit value)

Letter Grade	A+	A	B	C	D	E	F/I/DT
Credit value	10	9	8	7	6	5	0

F- Fail, DT - Detained/Attendance shortage, I - Incomplete

Internals Weightage (%)	**End semester Exam Weightage (%)**
30	70

Calculation of GPA & CGPA: An example is provided

Course code	**Course**	**Credits (a)**	**Grade obtained by the student**	**Credit value (b)**	**Grade Points (a x b)**
DMLT 1	Course - 1	4	D	6	24
DMLT 2	Course - 2	4	B	8	32
DMLT 3	Course - 3	3	A+	10	30
DMLT 4	Course - 4	4	C	7	28
DMLT -5	Course - 5	5	A	9	45
TOTAL		**20**	**-**	**-**	**159**

1st Semester GPA = Total grade points / total credits

159/20 = **7.95**

Suppose in **the 2nd semester, GPA** = **8.35** with respective course credit 20

$$Then, 1^{st} YearCGPA = \frac{(7.95x20) + (8.35x20)}{20 + 20} = 8.15$$

Progression Criteria to Higher Semesters

Eligibility for promotion to the next academic year is based on the following minimum academic performance requirements:

First Year to Second Year:

- A student must secure a minimum of **70% of the total credits** at the end of the first year (i.e., completion of both the first and second semesters).

Internship/Lab posting

- A student will be eligible to commence the **Internship (Lab posting/)** only after the **successful completion of all coursework**, i.e., **100% of the credits** must be earned before enrolling for internship/lab posting

Attendance :

- A candidate has to secure minimum -
- 80% attendance in theoretical
- 80% in Skills training (practical) for qualifying to appear for the final examination.
- No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition etc.

Program Completion Timeline

- All academic coursework must be completed within a maximum of **double the program duration**.
- For example, in a 2**-year program**, all requirements must be fulfilled within 4 **years** from the date of admission.

Note: Failure to complete the program within the stipulated maximum duration will result in **automatic exit** from the program.

3.3 Curriculum Scheme

Course Name: Introduction to Medical Laboratory Science

Credit= 2 (30 hours)

Course Rationale:

The medical laboratory is central to modern clinical decision-making, and this course serves as an entry point from general science to diagnostic practice. This course also introduces students to the fundamentals of medical laboratory science, including the role of laboratories in healthcare, basic laboratory organisation, safety practices, ethics, and an overview of diagnostic disciplines. It serves as a foundation for further technical training. In the Indian context—ranging from small collection centres to National Accreditation Board for Testing and Calibration Laboratories (NABL)-accredited hospitals—students must understand their role, ensure accuracy to avoid misdiagnosis, and follow safety norms such as the Bio-Medical Waste Management Rules.

Emphasis should be placed on the pre-analytical phase, where most diagnostic errors in India occur due to incorrect patient identification, poor sample collection, labelling, and transport—areas under direct control of the laboratory associate.

Learning Objectives

By the end of this course, the student will be able to:

- **Define** the role and ethics of a Medical Laboratory Associate in the Indian healthcare system.
- **Identify** and safely operate basic laboratory instrumentation (microscopes, centrifuges, etc.).
- **Demonstrate** proper Bio-Medical Waste (BMW) segregation as per Indian regulatory standards.
- **Understand** the "Total Testing Process" (Pre-analytical, Analytical, and Post-analytical phases).
- **Communicate** effectively and ethically with patients during sample collection.

Unit	Topic	Hours

I	**Introduction to Medical Laboratory Science**
	• **Definition, scope, and evolution** of medical laboratory science in modern healthcare
	• **Role of laboratory services** in:
	  ○ Disease diagnosis (screening and confirmation)
	  ○ Prognosis and disease monitoring
	  ○ Preventive healthcare and public health surveillance
	• **Types of laboratories**:
	  ○ Hospital-based laboratories
	  ○ Independent/private laboratories
	  ○ Reference and research laboratories
	  ○ Professional Hierarchy: Roles of the Lab Assistant, Associate (Diploma), Scientist (Degree), and Pathologist.
	• **Overview of diagnostic workflow**:
	  ○ Test requisition
	  ○ Sample collection
	  ○ Analysis (manual vs automated)
	  ○ Result validation and reporting
	• **Importance of laboratory data in clinical decision-making**
		5

II	**Organization of Clinical Laboratory**
	• **Structure and layout** of a standard clinical laboratory
	• **Detailed study of major laboratory departments**:
	  ○ Hematology (blood analysis)
	  ○ Clinical Biochemistry (body fluids and metabolites)
	  ○ Microbiology (infectious disease diagnosis)
	  ○ Histopathology & Cytology (tissue and cellular analysis)
	• **Roles and responsibilities of laboratory personnel**:
	  ○ Laboratory Associate/technologist
	  ○ Pathologist
	  ○ Phlebotomist
	  ○ Lab manager/quality officer
	• **Laboratory workflow and sample processing steps**:
	  ○ Pre-analytical, analytical, and post-analytical phases
		6

Unit	Topic	Hours

	Basic Laboratory Equipment & Techniques
	• **Microscopes**
	• **Centrifuge**
	• **Pipettes**
	• **Basic measurement techniques**
	• **Introduction to laboratory quality systems:**
	  ○ Standard operating procedures (SOPs)
	  ○ Documentation and record maintenance	

III	**Laboratory Safety and Biosafety**
	• **Concept and importance of biosafety in laboratories**
	• **Biosafety levels (BSL 1–4)**:
	  ○ Classification, requirements, and applications
	• **Personal Protective Equipment (PPE)**:
	  ○ Types, correct usage, and disposal
	• **Infection control practices**:
	  ○ Hand hygiene
	  ○ Disinfection and sterilization methods
	• **Biomedical waste management**:
	  ○ Categories of waste
	  ○ Segregation, collection, transport, and disposal as per Indian regulations
	• **Laboratory hazards and risk management**:
	  ○ Chemical, biological, and physical hazards
	• **Needle-stick injury management and post-exposure prophylaxis (PEP)**
	• **Emergency response procedures (spill management, fire safety basics)**
		6

IV	**Specimen Collection and Handling**
	• **Types of clinical specimens**:
	  ○ Blood, urine, stool, sputum, body fluids
	• **Principles of specimen collection**:
	  ○ Patient preparation
	  ○ Timing of sample collection
	• **Basic concepts of phlebotomy (theory)**:
	  ○ Venipuncture basics
	  ○ Anticoagulants and collection tubes (color coding)
	• **Specimen labeling, transport, and storage**:
	  ○ Cold chain maintenance
	  ○ Preservation techniques
		6

Unit	Topic	Hours

	• **Pre-analytical variables and errors**:
	  ○ Causes (improper collection, labeling errors, contamination)
	  ○ Impact on diagnostic accuracy
	  ○ Inclusion Criteria and exclusion criteria for specimen	

V	**Ethics and Professionalism**
	• **Principles of medical ethics in laboratory practice**:
	  ○ Autonomy, beneficence, non-maleficence, justice
	• **Patient confidentiality and data protection**:
	  ○ Handling of patient records and reports
	• **Informed consent in diagnostic procedures**
	• **Professional conduct and behavior**:
	  ○ Communication with clinicians and patients
	  ○ Teamwork and accountability
	• **Legal aspects and responsibilities of laboratory personnel**
		3

VI	**Quality in Laboratory Services**
	• **Concept of quality in laboratory diagnostics**
	• **Accuracy vs precision**:
	  ○ Definitions and significance in test results
	• **Quality Control (QC)**:
	  ○ Internal QC and external QC basics
	• **Quality Assurance (QA)**:
	  ○ Components and importance in laboratory functioning
	• **Standardization and validation of laboratory tests**
	• **Accreditation and certification**:
	  ○ Overview of National Accreditation Board for Testing and Calibration Laboratories guidelines
	  ○ Importance of accreditation in ensuring reliability and credibility
	• **Continuous quality improvement in laboratory services**
		4

Suggested Reading:

- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.
- Mukherjee, K. L. (2013). *Medical Laboratory Technology Volume 3* (Vol. 3). Tata McGraw-Hill Education.
- Sood, R. (2005). Medical laboratory technology. JAYPEE BROTHERS PUBLISHERS.
- **BMW Management Rules (2016):** Published by the Ministry of Environment, Forest and Climate Change, Government of India.
- **NABL 160:** Guidance document for Quality Assurance in Medical Laboratories.

Course Name: Communication, Professionalism and Ethics

Credit= 2 (30 hours)

Course Rationale:

In medical laboratory practice, technical accuracy must be complemented by effective communication, ethical conduct, and professional behavior. Laboratory professionals interact with patients, clinicians, and healthcare teams, where clear communication ensures correct sample collection, accurate reporting, and patient safety. Ethical principles such as confidentiality, informed consent, and integrity are essential to maintain trust and comply with healthcare standards. This course equips students with the necessary soft skills and ethical framework to function responsibly in clinical laboratory settings.

Learning Objective:

By the end of the course, students will be able to:

1. Develop effective verbal and non-verbal communication skills in healthcare settings
2. Demonstrate professional behavior and workplace etiquette
3. Apply ethical principles in laboratory practice
4. Understand patient rights, confidentiality, and informed consent
5. Communicate effectively with healthcare teams and patients

Unit	Topic	Hours

I	**Fundamentals of Communication**
	• **Definition, nature, and scope of communication** in healthcare settings
	• **Types of communication**:
	  ○ Verbal (oral and written)
	  ○ Non-verbal (body language, gestures, facial expressions, tone)
	• **Importance of effective communication** in patient care, teamwork, and error reduction
	• **Barriers to effective communication**:
	  ○ Physical, psychological, cultural, and language barriers
	  ○ Strategies to overcome communication barriers
	• **Communication process and models**:
	  ○ Sender–message–channel–receiver–feedback model
	  ○ Importance of feedback in ensuring message accuracy
	• **Listening skills**:
	  ○ Active listening techniques
	  ○ Empathy and attentiveness
	  ○ Providing and receiving constructive feedback
		5

II	**Communication in Healthcare Settings**
	• **Communication with patients**:
	  ○ Giving clear instructions for sample collection
	  ○ Demonstrating empathy, respect, and cultural sensitivity
	  ○ Handling anxious or uncooperative patients
	• **Communication with clinicians and healthcare teams**:
	  ○ Reporting critical values
	  ○ Maintaining clarity and accuracy in professional interactions
	• **Telephone and digital communication etiquette**:
	  ○ Professional tone, documentation, and confidentiality
	  ○ Use of electronic health records (EHRs) and digital platforms
	• **Documentation and report writing**:
	  ○ Principles of accurate and clear laboratory reporting
	  ○ Avoidance of errors in documentation
		5

Unit	Topic	Hours

	• **Handling difficult conversations**:
	  ○ Managing conflict and complaints
	  ○ De-escalation techniques
	  ○ Maintaining professionalism under stress	

III	**Professionalism in Healthcare**
	• **Definition and core attributes of professionalism**:
	  ○ Integrity, honesty, respect, accountability
	• **Workplace behavior and etiquette**:
	  ○ Dress code, punctuality, discipline
	  ○ Respectful communication with colleagues and patients
	• **Time management and work discipline**:
	  ○ Prioritization of tasks
	  ○ Meeting deadlines and maintaining efficiency
	• **Teamwork and interprofessional collaboration**:
	  ○ Roles within healthcare teams
	  ○ Importance of coordination and mutual respect
	• **Accountability and responsibility**:
	  ○ Ownership of tasks and results
	  ○ Ethical responsibility in reporting and handling samples
		5

IV	**Ethics in Medical Laboratory Practice**
	• **Concept and importance of ethics in healthcare**
	• **Principles of biomedical ethics**:
	  ○ **Autonomy**: Respecting patient choices
	  ○ **Beneficence**: Acting in the patient's best interest
	  ○ **Non-maleficence**: Avoiding harm
	  ○ **Justice**: Fair and equitable treatment
	• **Ethical dilemmas in laboratory practice**:
	  ○ Handling errors in reports
	  ○ Confidentiality breaches
	  ○ Reporting critical results
	• **Professional codes of conduct**:
	  ○ Ethical standards for laboratory professionals
	• **Ethical decision-making framework**:
	  ○ Identifying the problem
	  ○ Evaluating options
	  ○ Making ethical choices
	• Role of ethics in maintaining **trust and credibility** in laboratory services
		6

Unit	Topic	Hours

V	**Patient Rights and Confidentiality**
	• **Patient rights and responsibilities**:
	  ○ Right to information, privacy, and respectful care
	• **Confidentiality and privacy of patient data**:
	  ○ Handling laboratory reports and records
	  ○ Data protection in digital systems
	• **Informed consent**:
	  ○ Concept and importance in laboratory procedures
	  ○ Types of consent (implied, explicit)
	• **Legal implications of breach of confidentiality**:
	  ○ Consequences for healthcare professionals
	  ○ Case examples and preventive measures
		4

VII	**Legal and Regulatory Aspects**
	• **Legal responsibilities of laboratory personnel**:
	  ○ Duty of care and professional obligations
	• **Medical negligence and malpractice**:
	  ○ Definition, causes, and prevention
	• **Documentation and medico-legal records**:
	  ○ Importance of accurate record keeping
	  ○ Legal value of laboratory reports
	• **Overview of regulatory bodies (India context)**:
	  ○ National Accreditation Board for Testing and Calibration Laboratories (laboratory accreditation)
	  ○ Medical Council of India / National Medical Commission
	• Legal compliance in laboratory operations
		3

VIII	**Stress Management and Professional Development**
	• **Workplace stress in healthcare settings**:
	  ○ Causes (workload, errors, patient interactions)
	• **Stress management strategies**:
	  ○ Time management, relaxation techniques, work-life balance
	• **Emotional intelligence**:
	  ○ Self-awareness, self-regulation, empathy
	• **Professional growth and lifelong learning**:
	  ○ Continuing education and skill development
	• **Workplace ethics and integrity**:
	  ○ Maintaining honesty and commitment in professional practice
		2

Suggested Reading:

1. Thistlethwaite, J., & Spencer, J. (2018). *Professionalism in medicine*. CRC Press.

2. Davis, J. C. (2017). Medical Ethics in India. *Indian Moral Theology: Historical Studies and Future Prospects, Bangalore: Dharmaram Publications*.

3. Worthington, R., & Rohrbaugh, R. (2017). Medicine, ethics and professionalism in modern India. In *Health Policy and Ethics* (pp. 71-80). CRC Press.

Course Name: Basic Emergency Care

Credit= 2 (30 hours)

Course Rationale:

Medical laboratory professionals may encounter emergency situations such as patient collapse during sample collection, needle-stick injuries, or exposure to hazardous materials. Although not primary emergency responders, they must possess basic knowledge of emergency care to provide immediate assistance, ensure patient safety, and support clinical teams. This course equips students with essential life-saving principles, first aid knowledge, and emergency response skills relevant to laboratory and healthcare settings.

Learning Objective:

By the end of the course, students will be able to:

1. Understand the principles of basic emergency care and first aid
2. Recognize common medical emergencies and appropriate responses
3. Demonstrate knowledge of cardiopulmonary resuscitation (CPR) concepts
4. Apply basic first aid techniques for injuries and laboratory accidents
5. Understand infection control and safety during emergency situations

Unit	Topic	Hours

I	**Introduction to Emergency Care**
	Definition, scope, and significance of emergency care in healthcare delivery
	• **Principles of first aid**:
	  ○ Preservation of life
	  ○ Prevention of further injury
	  ○ Promotion of recovery
	• **Role and responsibilities of a first responder** in healthcare settings:
	  ○ Initial assessment of the victim
	  ○ Ensuring scene safety
	  ○ Activating emergency medical services
	• **Chain of survival concept**:
	  ○ Early recognition and call for help
	  ○ Early CPR
	  ○ Early defibrillation
	  ○ Advanced medical care
	• **Emergency preparedness in laboratories**:
	  ○ Emergency protocols and standard operating procedures (SOPs)
	  ○ Availability of first aid kits and emergency equipment
	  ○ Staff training and mock drills
		4

II	**Basic Life Support (BLS)**
	• **Concept, importance, and scope of Basic Life Support (BLS)**
	• **Recognition of life-threatening conditions**:
	  ○ Cardiac arrest
	  ○ Respiratory arrest and airway obstruction
	• **Steps of BLS (adult)**:
	  ○ Scene safety and patient assessment
	  ○ Checking responsiveness and breathing
	  ○ Activation of emergency response system
	• **Airway, Breathing, Circulation (ABC approach)**:
	  ○ Airway opening techniques (head tilt–chin lift, jaw thrust)
	  ○ Rescue breathing (conceptual understanding)
	  ○ Chest compressions (rate, depth, and positioning—conceptual)
		6

Unit	Topic	Hours

	• **Automated External Defibrillator (AED)**:
	  ○ Purpose and importance
	  ○ Basic operational steps (theoretical introduction)
	• **Recovery position**:
	  ○ Indications and procedure for unconscious breathing patients	

III	**Management of Common Medical Emergencies**
	• **Syncope (fainting)**:
	  ○ Causes, signs, and immediate management
	• **Shock**:
	  ○ Types (hypovolemic, cardiogenic, distributive)
	  ○ Recognition and first aid management
	• **Seizures**:
	  ○ Types and triggers
	  ○ First aid and safety precautions during seizures
	• **Respiratory emergencies**:
	  ○ Asthma attack: recognition and basic management
	• **Metabolic emergencies**:
	  ○ Hypoglycemia and hyperglycemia: signs and response
	• **Allergic reactions and anaphylaxis**:
	  ○ Identification of severe allergic reactions
	  ○ Immediate response and emergency referral
	• Emphasis on **timely recognition and referral to higher medical care**
		6

IV	**First Aid for Injuries**
	• **Bleeding and hemorrhage control**:
	  ○ Types of bleeding
	  ○ Methods of control (direct pressure, elevation, bandaging)
	• **Wounds and dressing techniques (theory)**:
	  ○ Types of wounds (abrasions, lacerations, punctures)
	  ○ Principles of wound care and infection prevention
	• **Burns and scalds**:
	  ○ Classification (first, second, third degree)
	  ○ Immediate first aid and precautions
		5

Unit	Topic	Hours

	• **Fractures and immobilization**:
	  ○ Types of fractures
	  ○ Principles of splinting and immobilization
	• **Head injuries and spinal precautions**:
	  ○ Recognition of serious injury
	  ○ Importance of immobilization and minimal movement	

V	**Laboratory-related Emergencies**
	• **Needle-stick injuries and exposure to blood/body fluids**:
	  ○ Immediate first aid measures
	  ○ Reporting protocols and documentation
	• **Chemical exposure and poisoning**:
	  ○ Routes of exposure (skin, inhalation, ingestion)
	  ○ Basic first aid and decontamination procedures
	• **Biological hazards and infection exposure**:
	  ○ Risk of infection transmission
	  ○ Immediate containment and reporting
	• **Fire safety in laboratories**:
	  ○ Types of fire and fire extinguishers (basic understanding)
	  ○ Fire response procedures (RACE principle)
	• **Electrical hazards**:
	  ○ Prevention and emergency response to electrical injuries
		4

VI	**Infection Control in Emergencies**
	• **Universal precautions**:
	  ○ Standard infection prevention practices
	• **Personal Protective Equipment (PPE)**:
	  ○ Types, proper use, and disposal
	• **Safe handling of contaminated materials**:
	  ○ Biomedical waste segregation and disposal
	• **Post-exposure prophylaxis (PEP)**:
	  ○ Concept and importance
	  ○ Basic protocol following exposure to infectious agents
	• Role of infection control in **protecting healthcare workers and patients**
		3

Unit	Topic	Hours

VI	**Disaster Management and Triage**
	• **Concept and principles of disaster management**
	• **Types of disasters**:
	  ○ Natural (earthquakes, floods)
	  ○ Man-made (industrial accidents, fires)
	• **Principles of triage**:
	  ○ Prioritization of patients based on severity
	  ○ Color coding system (basic understanding)
	• **Role of healthcare workers and laboratory personnel**:
	  ○ Support in mass casualty situations
	  ○ Coordination with emergency services
	• Importance of preparedness and **interdisciplinary teamwork** during disasters
		2

Suggested Reading:

1. World Health Organization. (2018). *Basic emergency care: approach to the acutely ill and injured*. World Health Organization.

2. American Heart Association. (2016). *Basic life support (BLS) provider manual*. Amer Heart Assoc.

Course Name: Basics of Medical Terminology

Credit= 2 (30 hours)

Course Rationale:

Medical terminology forms the foundational language of healthcare and laboratory sciences. For DMLT students, understanding medical terms is essential for accurate interpretation of laboratory requests, reports, diagnostic procedures, and communication with clinicians. This course equips students with the ability to decode complex medical vocabulary by understanding roots, prefixes, and suffixes, thereby improving accuracy, efficiency, and professionalism in clinical laboratory practice.

Learning Objective:

By the end of this course, students will be able to:

1. Understand the structure and formation of medical terms (prefixes, suffixes, root words).
2. Interpret and construct medical terms related to body systems and laboratory investigations.
3. Use appropriate medical terminology in laboratory documentation and communication.
4. Recognize commonly used abbreviations and symbols in healthcare settings.
5. Apply terminology knowledge in understanding clinical conditions and diagnostic procedures.
6. Minimize errors in laboratory reporting due to misinterpretation of terms.

Unit	Topic	Hours

I	**Introduction to Medical Terminology**
	Definition and Importance
	• Meaning and origin of medical terminology (Greek and Latin roots)
	• Role in healthcare communication, especially in laboratory settings
	• Importance in:
	  ○ Understanding test requisition forms
	  ○ Interpreting laboratory reports
	  ○ Avoiding diagnostic and reporting errors
	2. Word Structure
	• **Root words:** Basic meaning (e.g., *cardi* – heart, *hemat* – blood)
	• **Prefixes:** Indicate number, location, time, status (e.g., *hyper*, *hypo*, *brady*, *tachy*)
	• **Suffixes:** Indicate procedures, conditions, diseases (e.g., *-itis*, *-emia*, *-ology*)
	• **Combining forms:** Use of vowels (usually "o") to join word parts
	3. Rules for Building Medical Terms
	• Order of components (prefix + root + suffix)
	• Use of combining vowels
	• Singular and plural forms (e.g., *bacterium* → *bacteria*)
	• Pronunciation and spelling rules
	4. Common Medical Abbreviations and Symbols
	• Frequently used abbreviations in lab practice (e.g., Hb, WBC, RBC, BP, ECG)
	• Units of measurement (mg/dL, mmol/L)
	• Safety-related symbols in laboratories
		5

II	**Terminology of Human Body Systems – I** **1. Skeletal and Muscular System** • Key terms: *oste/o*, *arthr/o*, *my/o* • Common conditions: fracture, arthritis, osteoporosis, myopathy • Diagnostic terms: X-ray, MRI, bone marrow examination • Lab relevance: calcium levels, creatine kinase (CK)	8

Unit	Topic	Hours
	2. Cardiovascular System • Terms: *cardi/o*, *vas/o*, *hemat/o* • Conditions: hypertension, myocardial infarction, anemia • Diagnostic procedures: ECG, angiography • Lab relevance: lipid profile, cardiac enzymes (troponin, CK-MB) **3. Respiratory System** • Terms: *pulmon/o*, *pneum/o*, *bronch/o* • Conditions: asthma, pneumonia, tuberculosis • Diagnostic terms: spirometry, bronchoscopy • Lab relevance: sputum examination, arterial blood gases (ABG)	
III	**Terminology of Human Body Systems – II** **1. Digestive System** • Terms: *gastr/o*, *hepat/o*, *enter/o* • Conditions: gastritis, hepatitis, peptic ulcer • Diagnostic procedures: endoscopy, colonoscopy • Lab relevance: liver function tests (LFT), stool examination **2. Urinary System** • Terms: *nephr/o*, *ren/o*, *cyst/o* • Conditions: nephritis, renal failure, urinary tract infection (UTI) • Diagnostic terms: urinalysis, cystoscopy • Lab relevance: urine examination, kidney function tests (KFT) **3. Reproductive System** • Terms: *gynec/o*, *andr/o*, *orchid/o* • Conditions: infertility, infections, tumors • Diagnostic procedures: Pap smear, semen analysis • Lab relevance: hormone assays, reproductive biomarkers	8
IV	**Terminology of Human Body Systems – III** **1. Nervous System** • Terms: *neur/o*, *encephal/o*, *myel/o* • Conditions: epilepsy, meningitis, neuropathy • Diagnostic procedures: EEG, lumbar puncture • Lab relevance: cerebrospinal fluid (CSF) analysis	5

Unit	Topic	Hours
	2. Endocrine System • Terms: *thyroid/o*, *pituitar/o*, *adren/o* • Conditions: diabetes mellitus, hypothyroidism, hyperthyroidism • Diagnostic procedures: hormone assays • Lab relevance: blood glucose, thyroid function tests (TFT) **3. Immune and Lymphatic System** • Terms: *immun/o*, *lymph/o*, *splen/o* • Conditions: infections, autoimmune diseases, lymphoma • Diagnostic terms: ELISA, serology • Lab relevance: antigen-antibody reactions **4. Terminology Related to Infections and Immunity** • Terms: infection, inflammation, pathogen, immunity • Types: bacterial, viral, fungal infections • Laboratory terms: culture, sensitivity, staining techniques	
V	**Laboratory and Clinical Terminology** **1. Terminology in Laboratory Departments** • **Hematology:** anemia, leukocytosis, thrombocytopenia • **Microbiology:** culture, colony, pathogen, antibiotic sensitivity • **Biochemistry:** enzymes, metabolites, electrolytes • **Pathology:** biopsy, histology, cytology **2. Diagnostic Procedures and Specimen Terminology** • Types of specimens: blood, urine, sputum, CSF, tissue • Collection methods: venipuncture, biopsy, swabs • Handling and labeling terminology **3. Interpretation of Common Laboratory Test Names** • CBC (Complete Blood Count) • LFT, KFT • Lipid profile • Blood glucose tests • Understanding test panels and reports	4

Suggested Reading:

1. Chabner, D. E. (2022). *Medical Terminology: A Short Course-E-Book: Medical Terminology: A Short Course-E-Book*. Elsevier Health Sciences.

2. Gylys, B. A., & Wedding, M. E. (2017). *Medical terminology systems: a body systems approach*. FA Davis.

3. Ehrlich, A., & Schroeder, C. L. (2021). *Medical terminology for health professionals*. Delmar Cengage Learning.

Course Name: Basics of Human Anatomy and Physiology

Credit= 4 (60 hours)

Course Rationale:

A clear understanding of human anatomy and physiology is fundamental for medical laboratory professionals to interpret laboratory results accurately and correlate them with normal and pathological conditions. This course provides essential knowledge of the structure and function of the human body systems, enabling students to understand disease mechanisms, specimen relevance, and diagnostic significance. It forms the scientific basis for all clinical laboratory investigations.

Learning Objective:

By the end of the course, students will be able to:

1. Describe the basic structure and organization of the human body
2. Explain the functions of major organ systems
3. Correlate physiological processes with laboratory investigations
4. Understand homeostasis and its importance in health
5. Identify normal vs altered physiological states relevant to diagnostics

Unit	Topic	Hours

I	**Introduction to Anatomy and Physiology**
	• **Definition, scope, and branches** of anatomy (gross, microscopic, applied) and physiology
	• **Levels of structural organization**:
	  ○ Chemical → Cellular → Tissue → Organ → Organ system → Organism
	• **Basic anatomical terminology**:
	  ○ Anatomical position
	  ○ Directional terms (anterior, posterior, medial, lateral, proximal, distal)
	  ○ Body planes (sagittal, coronal, transverse) and body cavities
	• **Concept of homeostasis**:
	  ○ Internal environment regulation
	  ○ Feedback mechanisms (negative and positive feedback)
	• **Overview of major body systems** and their interrelationship
	• Importance of anatomy and physiology in **clinical laboratory diagnosis**
		6

II	**Cell Structure and Tissue Organization**
	• **Structure and function of the cell**:
	  ○ Cell membrane, cytoplasm, nucleus
	  ○ Cell organelles (mitochondria, ribosomes, ER, Golgi apparatus, lysosomes)
	• **Cell membrane transport mechanisms**:
	  ○ Diffusion, facilitated diffusion, active transport, osmosis
	• **Cell division**:
	  ○ Mitosis (growth and repair)
	  ○ Meiosis (reproduction – basic overview)
	• **Types of tissues**:
	  ○ **Epithelial tissue**: structure, types, functions (protection, secretion)
	  ○ **Connective tissue**: bone, blood, cartilage, adipose
	  ○ **Muscular tissue**: skeletal, smooth, cardiac
	  ○ **Nervous tissue**: neurons and neuroglia
	• Functional significance of tissues in **organ systems and disease states**
		6

Unit	Topic	Hours

III	**Skeletal System**
	• **Structure and functions of bones**:
	  ○ Support, protection, movement, mineral storage
	• **Types of bones**:
	  ○ Long, short, flat, irregular
	• **Bone composition and structure**:
	  ○ Compact and spongy bone
	  ○ Bone marrow (red and yellow)
	• **Axial and appendicular skeleton**:
	  ○ Skull, vertebral column, ribs
	  ○ Limbs and girdles
	• **Joints**:
	  ○ Types (fibrous, cartilaginous, synovial)
	  ○ Range of movements
	• **Hematopoiesis**:
	  ○ Formation of blood cells in bone marrow
	  ○ Clinical relevance in anemia and blood disorders
		6

IV	**Muscular System**
	• **Types of muscles**:
	  ○ Skeletal (voluntary)
	  ○ Smooth (involuntary)
	  ○ Cardiac (specialized)
	• **Structure of muscle fibers**:
	  ○ Myofibrils, actin, and myosin filaments
	• **Mechanism of muscle contraction** (sliding filament theory – basic concept)
	• **Functions of muscular system**:
	  ○ Movement, posture, heat production
	• Clinical correlation:
	  ○ Muscle fatigue, cramps, and disorders
		5

V	**Cardiovascular System**
	• **Structure of the heart**:
	  ○ Chambers, valves, and blood flow pathway
	• **Blood vessels**:
	  ○ Arteries, veins, capillaries
	• **Cardiac cycle**:
	  ○ Systole and diastole
	• **Heart rate and its regulation**:
	  ○ Nervous and hormonal control
		8

Unit	Topic	Hours

	• **Blood composition and functions**:
	  ○ Plasma, RBCs, WBCs, platelets
	• **Circulation**:
	  ○ Systemic and pulmonary circulation
	• **Blood pressure**:
	  ○ Definition, normal values, regulation
	• **Clinical correlation**:
	  ○ Hemoglobin estimation, CBC, blood grouping
	  ○ Relevance in anemia, infections, and cardiovascular diseases	

VI	**Respiratory System**
	• **Structure of respiratory organs**:
	  ○ Nose, pharynx, larynx, trachea, lungs
	• **Mechanism of breathing**:
	  ○ Inspiration and expiration
	• **Gas exchange**:
	  ○ Oxygen and carbon dioxide transport
	• **Regulation of respiration**:
	  ○ Neural and chemical control
	• **Clinical relevance**:
	  ○ Oxygen saturation (SpO_2)
	  ○ Basics of arterial blood gases (ABG)
	  ○ Respiratory disorders (asthma, COPD – overview)
		5

VII	**Digestive System**
	• **Structure and functions of digestive organs**:
	  ○ Mouth, esophagus, stomach, intestines
	• **Process of digestion**:
	  ○ Mechanical and chemical digestion
	• **Absorption of nutrients**:
	  ○ Small intestine and role of villi
	• **Accessory organs**:
	  ○ Liver (bile production, metabolism)
	  ○ Pancreas (digestive enzymes, insulin)
	• **Metabolism basics**:
	  ○ Carbohydrate, protein, and fat metabolism
	• **Clinical correlation**:
	  ○ Liver function tests (LFTs)
	  ○ Enzyme markers (ALT, AST, amylase)
		6

Unit	Topic	Hours

VIII	**Urinary System**
	• **Structure of kidney and nephron**
	• **Formation of urine**:
	  ○ Filtration, reabsorption, secretion
	• **Fluid and electrolyte balance**:
	  ○ Sodium, potassium regulation
	• **Acid-base balance**:
	  ○ Role of kidneys in maintaining pH
	• **Clinical relevance**:
	  ○ Renal function tests (urea, creatinine)
	  ○ Urinalysis
		5

IX	**Nervous System**
	• **Organization of nervous system**:
	  ○ Central nervous system (CNS)
	  ○ Peripheral nervous system (PNS)
	• **Structure of neuron and nerve fibers**
	• **Nerve impulse transmission** (basic concept)
	• **Reflex action**:
	  ○ Reflex arc and its components
	• **Functions of nervous system**:
	  ○ Coordination, control, and integration
	• Clinical correlation:
	  ○ Neurological disorders (basic overview)
		5

X	**Endocrine System**
	• **Major endocrine glands**:
	  ○ Pituitary, thyroid, adrenal, pancreas
	• **Hormones and their functions**
	• **Regulation of hormone secretion**:
	  ○ Feedback mechanisms
	• **Clinical relevance**:
	  ○ Thyroid disorders (hypo/hyperthyroidism)
	  ○ Diabetes mellitus (insulin function)
		4

XI	**Reproductive System**
	• **Structure of male and female reproductive systems**
	• **Gametogenesis**:
	  ○ Spermatogenesis and oogenesis (overview)
	• **Hormonal regulation**:
	  ○ Role of sex hormones
		4

Unit	Topic	Hours
	• **Menstrual cycle**: ○ Phases and hormonal control • Basic understanding of **fertility and reproductive health**	

Suggested Reading:

1. Sembulingam, K. (2019). *Essentials of Medical Physiology: With Free Review of Medical Physiology*. Jaypee Brothers medical publishers.

2. Gupta, R., Ratra, M., Kamari, N., Sharma, R., & Dhiman, D. (2022). *Human anatomy and physiology*. Walnut Publication.

Course Name: Clinical Chemistry and Instrumentation

Credit= 4 (60 hours)

Course Rationale:

Clinical chemistry plays a pivotal role in modern diagnostics by analyzing biochemical constituents of body fluids to detect, monitor, and predict disease states. With the rapid evolution of laboratory technologies—from manual methods to fully automated analyzers—DMLT students must possess both conceptual understanding and technical knowledge of biochemical tests and instruments. This course provides in-depth knowledge of biochemical parameters, organ function tests, analytical techniques, and instrumentation, along with quality assurance practices. It prepares students to deliver accurate, reliable, and timely laboratory results in diverse healthcare settings.

Learning Objective:

By the end of this course, students will be able to:

1. Explain the principles and scope of clinical chemistry in disease diagnosis and monitoring.
2. Describe metabolism and clinical significance of major biochemical constituents.
3. Perform calculations and interpret results of routine and specialized biochemical tests.
4. Explain the principles, components, and working of laboratory instruments.
5. Understand automation, calibration, and maintenance of analyzers.
6. Apply quality control measures and ensure accuracy in laboratory results.
7. Identify sources of analytical errors and implement troubleshooting strategies.
8. Follow laboratory safety, waste management, and ethical practices.

Unit	Topic	Hours
I	**Introduction to Clinical Chemistry** **1. Definition, Scope, and Role** • Definition and evolution of clinical chemistry • Role in diagnosis, prognosis, and monitoring of diseases • Integration with other laboratory disciplines **2. Organization of a Clinical Chemistry Laboratory** • Layout and workflow of laboratory • Sections: sample collection, processing, analysis, reporting • Roles of laboratory personnel **3. Types of Biological Samples** • Blood: whole blood, serum, plasma (differences and uses) • Urine: random, 24-hour collection • CSF and other body fluids: pleural, peritoneal, synovial • Selection of appropriate sample based on test **4. Pre-Analytical Variables** • Patient preparation: fasting, posture, medication effects • Specimen collection techniques: venipuncture, anticoagulants (EDTA, heparin, citrate) • Factors affecting results: hemolysis, lipemia, contamination **5. Sample Handling and Processing** • Labeling and documentation • Transport conditions (temperature, time) • Centrifugation and separation • Storage requirements for different analytes **6. Analytical and Post-Analytical Phases** • Analytical methods and instrumentation basics • Result validation and verification • Reporting formats and turnaround time (TAT) **7. Units, Reference Ranges, and Critical Values** • SI units and conventional units • Biological variation and reference intervals • Concept of critical (panic) values and reporting protocols	8
II	**Carbohydrates and Diabetes** **1. Carbohydrate Metabolism** • Glycolysis, gluconeogenesis, glycogenolysis • Hormonal regulation (insulin, glucagon) **2. Blood Glucose Estimation Methods** • **GOD-POD method:** principle, reaction steps, advantages • **Hexokinase method:** reference method and accuracy • Sources of error and interferences	8

Unit	Topic	Hours
	3. Glucose Tolerance Test (GTT) • Indications and procedure • Interpretation of normal and abnormal curves **4. Glycated Hemoglobin (HbA1c)** • Formation and clinical significance • Role in long-term glucose monitoring **5. Diabetes Mellitus** • Types: Type 1, Type 2, gestational • Biochemical changes and complications (ketoacidosis, nephropathy) **6. Interpretation** • Fasting blood sugar (FBS), postprandial blood sugar (PPBS) • Diagnostic criteria and clinical correlation	
III	**Proteins and Enzymes** **1. Plasma Proteins** • Albumin, globulins, fibrinogen • A/G ratio and clinical importance **2. Protein Metabolism and Disorders** • Protein synthesis and degradation • Conditions: hypoproteinemia, hyperproteinemia, paraproteinemia **3. Enzymes: Basics** • Classification (oxidoreductases, transferases, hydrolases, etc.) • Enzyme kinetics: factors affecting enzyme activity **4. Clinical Enzymology** • **Liver enzymes:** ALT, AST, ALP (hepatocellular vs obstructive patterns) • **Cardiac markers:** CK-MB, troponin (myocardial infarction) • **Pancreatic enzymes:** amylase, lipase (pancreatitis) **5. Isoenzymes** • Definition and types (e.g., LDH isoenzymes) • Diagnostic applications	8
IV	**Lipids and Cardiovascular Risk** **1. Lipid Metabolism** • Digestion, absorption, and transport of lipids • Role of liver in lipid metabolism **2. Lipoproteins** • HDL, LDL, VLDL, chylomicrons • Functions and clinical significance	6

Unit	Topic	Hours
	3. Lipid Profile • Total cholesterol, triglycerides, HDL, LDL • Calculation of LDL (Friedewald formula – basic concept) **4. Dyslipidemia and Atherosclerosis** • Types and causes • Risk factors for cardiovascular disease **5. Interpretation** • Normal vs abnormal lipid levels • Clinical decision-making	
V	**Organ Function Tests** **A. Liver Function Tests (LFT)** • Bilirubin metabolism (unconjugated vs conjugated) • Types of jaundice: hemolytic, hepatic, obstructive • Liver enzymes and proteins • Interpretation of LFT patterns **B. Kidney Function Tests (KFT)** • Urea, creatinine, uric acid: metabolism and excretion • GFR: estimation and significance • Renal disorders: acute and chronic kidney disease **C. Electrolytes** • Sodium, potassium, chloride, calcium, phosphorus • Regulation by kidneys and hormones • Clinical significance of imbalance **D. Acid-Base Balance** • pH regulation, buffers, respiratory and renal control • Acidosis and alkalosis: types and interpretation	10
VI	**Hormones and Endocrine Function** **1. Basic Endocrinology** • Hormone classification and mechanism of action • Feedback regulation **2. Thyroid Function Tests** • T3, T4, TSH • Disorders: hypothyroidism, hyperthyroidism **3. Adrenal and Pancreatic Hormones** • Cortisol, aldosterone, insulin • Disorders: Addison's disease, Cushing's syndrome, diabetes **4. Laboratory Diagnosis** • Immunoassay principles (basic concept) • Interpretation of hormone levels	6

Unit	Topic	Hours
VII	**Analytical Techniques and Instrumentation** **1. Analytical Techniques** • **Colorimetry:** Beer-Lambert law, applications • **Spectrophotometry:** principles, wavelength selection • **Flame photometry:** estimation of electrolytes • **Electrophoresis:** separation of proteins **2. Laboratory Instruments** • Components and working: ○ Centrifuge (principle and types) ○ pH meter (measurement of acidity/alkalinity) ○ Incubator and water bath (temperature control) **3. Automation** • Semi-automated analyzers: features and operation • Fully automated analyzers: advantages and workflow **4. Point-of-Care Testing (POCT)** • Definition and examples (glucometer) • Advantages and limitations	8
VIII	**Quality Control and Laboratory Management** **1. Quality Assurance** • Importance in laboratory diagnostics • Components of quality system **2. Quality Control** • Internal Quality Control (IQC): control samples • External Quality Assurance (EQA): proficiency testing **3. Calibration and Validation** • Use of standards and calibrators • Method validation parameters (accuracy, precision) **4. Statistical Quality Control** • Levey-Jennings charts • Westgard rules (basic interpretation) **5. Sources of Errors** • Pre-analytical, analytical, post-analytical errors • Prevention strategies **6. Laboratory Safety and Management** • Biosafety levels and precautions • Biomedical waste management • Instrument maintenance and troubleshooting	6

Suggested Reading:

1. Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2020). *Clinical chemistry: Principles, techniques, and correlations* (9th ed.). Wolters Kluwer.
2. Burtis, C. A., & Bruns, D. E. (2019). *Tietz fundamentals of clinical chemistry and molecular diagnostics* (8th ed.). Elsevier.
3. Gowenlock, A. H., McMurray, J. R., & McLauchlan, D. M. (2018). *Varley's practical clinical biochemistry* (6th ed.). CBS Publishers & Distributors.
4. Kaplan, L. A., & Pesce, A. J. (2017). *Clinical chemistry: Theory, analysis, correlation* (5th ed.). Elsevier.
5. Cheesbrough, M. (2010). *District laboratory practice in tropical countries* (Part 1, 2nd ed.). Cambridge University Press.
6. Henry, J. B. (2016). *Henry's clinical diagnosis and management by laboratory methods* (23rd ed.). Elsevier.

Course Name: Human Anatomy and Physiology Practical

Credit= 2 (30 hours)

Course Rationale:

A strong understanding of human anatomy and physiology is essential for medical laboratory professionals, as it forms the foundation for interpreting laboratory results in relation to normal and pathological conditions. This practical course is designed to provide hands-on exposure to the structure and function of the human body using models, specimens, charts, and basic physiological experiments. It enables students to correlate theoretical knowledge with real-life laboratory observations, thereby improving diagnostic accuracy, technical competence, and clinical understanding required in routine laboratory practice.

Learning Objective:

By the end of this course, students will be able to:

1. Identify major organs and structures of the human body using models, charts, and specimens.
2. Demonstrate basic understanding of physiological functions through simple experiments.
3. Correlate anatomical structures with their functions in different body systems.
4. Perform basic physiological measurements such as pulse, blood pressure, and respiratory rate.
5. Understand normal physiological values and their clinical significance.
6. Apply knowledge of anatomy and physiology in laboratory sample collection and handling.
7. Develop observational, recording, and reporting skills relevant to medical laboratory practice.

Unit	Topic	Hours
I	**Introduction to Laboratory and Instruments (3 Hours)** • Familiarization with laboratory equipment • Safety measures and ethical practices • Identification of anatomical charts and models	3
II	**Study of Human Anatomy using Models & Specimens** • Skeletal system: identification of bones • Digestive system: organs and structure • Respiratory system: lungs and airway structures • Cardiovascular system: heart structure • Nervous system: brain and spinal cord • Urinary and reproductive systems	10

III	**Histology (Microscopic Study)**
	• Identification of basic tissues:
	  ○ Epithelial tissue
	  ○ Connective tissue
	  ○ Muscle tissue
	  ○ Nervous tissue
	• Slide observation and labeling
		5

IV	**Basic Physiological Experiments** • Measurement of pulse rate • Measurement of blood pressure • Recording respiratory rate • Body temperature measurement • Hemoglobin estimation (demonstration/basic method) • Blood grouping (demonstration)	8
V	**Clinical Correlation & Recording** • Recording observations and report writing • Interpretation of normal vs abnormal values • Clinical relevance of physiological parameters	4

Suggested Reading:

- Ross and Wilson Anatomy and Physiology in Health and Illness
  Waugh, A., & Grant, A. (2022). *Ross and Wilson anatomy and physiology in health and illness* (14th ed.). Elsevier.
- Guyton and Hall Textbook of Medical Physiology
  Hall, J. E. (2021). *Guyton and Hall textbook of medical physiology* (14th ed.). Elsevier.
- Essentials of Human Anatomy and Physiology
  Marieb, E. N., & Keller, S. M. (2019). *Essentials of human anatomy and physiology* (12th ed.). Pearson.
- Textbook of Practical Physiology
  Pal, G. K., & Pal, P. (2017). *Textbook of practical physiology* (4th ed.). Universities Press.
- BD Chaurasia's Human Anatomy
  Chaurasia, B. D. (2019). *BD Chaurasia's human anatomy* (Vols. 1–3, 8th ed.). CBS Publishers.

Course Name: Introduction to Medical Laboratory Science

Credit= 2 (30 hours)

Course Rationale:

Clinical chemistry laboratories rely heavily on precise analytical techniques and advanced instrumentation for accurate diagnosis and monitoring of diseases. For DMLT students, hands-on training is essential to develop technical competence in performing biochemical tests, operating instruments, and maintaining quality standards. This course provides practical exposure to routine clinical chemistry investigations and commonly used laboratory instruments, enabling students to ensure reliability, accuracy, and safety in real-world laboratory settings.

Learning Objective:

By the end of this course, students will be able to:

1. Perform basic clinical chemistry tests using standard procedures.
2. Operate common laboratory instruments such as colorimeter and centrifuge.
3. Prepare reagents, standards, and calibration curves.
4. Apply principles of quality control in laboratory testing.
5. Identify and minimize sources of laboratory errors.
6. Maintain laboratory records and interpret test results.
7. Follow safety protocols and good laboratory practices.

Unit	Topic	Hours
	Unit I: Laboratory Orientation & Safety • Familiarization with clinical chemistry laboratory setup • Use of glassware and equipment • Safety precautions and PPE usage • Biomedical waste disposal	3
II	**Basic Laboratory Techniques** • Pipetting techniques (manual and micropipettes) • Preparation of reagents and standard solutions • Calibration and use of balances • Preparation of calibration curves	5
III	**Instrumentation Handling** • Operation of colorimeter • Spectrophotometer (demonstration/handling) • Centrifuge usage and maintenance • pH meter operation • Flame photometer (demonstration) • Introduction to semi-auto analyzer	8
IV	**Routine Clinical Chemistry Tests (10 Hours)** (Perform/observe and record results) • Blood glucose estimation (GOD-POD method) • Urea estimation • Creatinine estimation • Serum cholesterol estimation • Total protein estimation • Bilirubin estimation • Enzyme assay (SGOT/SGPT – demonstration/basic)	10
V	**Quality Control & Result Interpretation** • Internal quality control procedures • Use of control sera • Recording and interpretation of results • Identification of errors and corrective measures	4

Suggested Reading:

- Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics Burtis, C. A., & Bruns, D. E. (2022). *Tietz fundamentals of clinical chemistry and molecular diagnostics* (8th ed.). Elsevier.
- Clinical Chemistry Principles Techniques and Correlations Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2020). *Clinical chemistry: Principles, techniques, and correlations* (8th ed.). Wolters Kluwer.
- Textbook of Medical Laboratory Technology Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vol. 1–3). Tata McGraw-Hill.
- Practical Clinical Biochemistry Varley, H., Gowenlock, A. H., & Bell, M. (2018). *Varley's practical clinical biochemistry* (6th ed.). CBS Publishers.
- Textbook of Practical Physiology Pal, G. K., & Pal, P. (2017). *Textbook of practical physiology* (4th ed.). Universities Press.

Course Name: Clinical Applications 1- Clinical Chemistry (Supervised Lab Rotation)

Credits: 2 (90 Hours)

The purpose of this course is to provide students with **structured, supervised hands-on training in clinical biochemistry laboratories**, enabling them to develop essential competencies required for routine diagnostic testing.

This rotation bridges the gap between **theoretical knowledge and real-world laboratory practice** by exposing learners to **actual patient samples, laboratory workflows, and diagnostic equipment**.

The course is designed to:

- Develop proficiency in the **pre-analytical, analytical, and post-analytical phases** of clinical chemistry testing
- Train students in performing **routine biochemical investigations** such as glucose, urea, and creatinine estimation
- Build competence in the **operation, calibration, and maintenance of laboratory instruments**
- Instill principles of **quality control, accuracy, and result validation**
- Promote adherence to **biosafety, infection control, and ethical laboratory practices**
- Enhance the ability to **record, interpret, and report laboratory findings effectively**

Through supervised clinical exposure, the course prepares students to function as **competent Medical Laboratory Associates**, capable of contributing to **diagnostic services, patient care, and laboratory quality systems**.

1. Rotation Overview

This supervised rotation provides **real laboratory exposure** to clinical biochemistry, focusing on:

- Sample handling and processing
- Routine biochemical investigations
- Instrument operation
- Quality control and reporting

2. Learning Outcomes

At the end of 90 hours, the student will be able to:

Skills

- Perform routine biochemical tests (glucose, urea, creatinine)
- Operate **colorimeter and semi-auto analyzer**
- Handle specimens safely and correctly
- Maintain QC records

Knowledge (Applied)

- Understand test principles
- Interpret basic results

Attitude

- Follow safety protocols
- Maintain accuracy and documentation

3. Hour-wise Practical Distribution (Total: 90 Hours)

Unit	Practical Component	Hours
Unit 1	Lab Orientation & Safety	6
Unit 2	Sample Collection & Pre-Analytical Handling	10
Unit 3	Sample Processing (Centrifugation, Serum Separation)	10
Unit 4	Basic Biochemistry Tests (Manual Methods)	20
Unit 5	Instrumentation (Colorimeter & Analyzer)	15
Unit 6	Routine Biochemical Panels	15
Unit 7	Quality Control & Calibration	8
Unit 8	Reporting & Documentation	6
Total		**90 Hours**

4. Detailed Practical Components

Unit 1: Lab Orientation & Safety (6 hrs)

- Introduction to clinical chemistry lab
- PPE usage
- Chemical safety
- Waste disposal

✓ **Competency:** Safety compliance

Unit 2: Sample Collection & Handling (10 hrs)

- Types of samples (serum, plasma)
- Labeling and identification
- Transport and storage

✓ **Competency Level:** Observe → Assist

Unit 3: Sample Processing (10 hrs)

- Centrifugation
- Serum/plasma separation
- Avoiding hemolysis

✓ **Competency Level:** Assist → Perform

Unit 4: Manual Biochemical Tests (20 hrs)

- Blood glucose
- Urea
- Creatinine

✓ **Pipetting**

✓ **Reagent preparation**

✓ **Calculation of results**

✓ **Core Competency (Must Perform Independently)**

Unit 5: Instrumentation (15 hrs)

- Colorimeter operation
- Semi-auto analyzer use
- Calibration basics

✓ **Competency Level:** Perform

Unit 6: Routine Biochemical Panels (15 hrs)

- Liver function tests (LFT) – demo/assist
- Kidney function tests (RFT) – perform basic parameters
- Lipid profile (overview/demo)

Unit 7: Quality Control & Calibration (8 hrs)

- QC samples
- Control charts
- Error identification

✓ **Competency:** QA awareness

Unit 8: Reporting & Documentation (6 hrs)

- Recording results
- Reference ranges
- Report formatting

Course Name: Introduction to Medical Microbiology

Credit= 4 (60 hours)

Course Rationale:

Medical microbiology is a foundational subject for medical laboratory professionals, providing essential knowledge about microorganisms responsible for human diseases. Understanding microbial structure, growth, pathogenicity, and laboratory identification is critical for accurate diagnosis and infection control. This course equips DMLT students with the theoretical basis required for microbiological investigations, supporting clinical decision-making and public health interventions, particularly in the context of emerging and re-emerging infectious diseases.

Learning Objective:

By the end of this course, students will be able to:

1. Explain the scope and importance of medical microbiology in healthcare.
2. Classify and describe different groups of microorganisms.
3. Understand microbial structure, physiology, and growth characteristics.
4. Explain mechanisms of microbial pathogenicity and host response.
5. Describe principles of sterilization, disinfection, and infection control.
6. Understand laboratory diagnostic methods for infectious diseases.
7. Recognize the role of microbiology in epidemiology and public health.
8. Apply biosafety and biosecurity principles in laboratory practice.

Unit	Topic	Hours
	Unit I: Introduction and History of Microbiology (6 Hours) **1. Definition and Scope** • Definition of microbiology and medical microbiology • Scope in healthcare, diagnostics, research, and public health • Importance in emerging and re-emerging infectious diseases **2. Branches of Microbiology** • Bacteriology, Virology, Mycology, Parasitology • Immunology and Microbial genetics (introductory) • Applied microbiology (clinical, industrial, environmental) **3. Historical Developments** • Contributions of Louis Pasteur: ○ Fermentation and pasteurization ○ Disproving spontaneous generation ○ Development of vaccines (rabies, anthrax) • Contributions of Robert Koch: ○ Koch's postulates ○ Discovery of causative agents of tuberculosis and cholera **4. Germ Theory of Disease** • Concept and significance • Transition from miasma theory to germ theory • Application in infection control **5. Role in Medicine and Diagnostics** • Identification of pathogens • Disease diagnosis and monitoring • Antimicrobial therapy guidance • Epidemiology and outbreak investigation	6
II	**Classification of Microorganisms (6 Hours)** **1. Major Groups of Microorganisms** • Bacteria: unicellular prokaryotes • Viruses: obligate intracellular parasites • Fungi: yeasts and molds • Parasites: protozoa and helminths **2. Prokaryotes vs Eukaryotes** • Structural differences (nucleus, organelles) • Reproduction and genetic organization • Examples relevant to human disease	6

Unit	Topic	Hours
	3. Normal Flora vs Pathogens • Definition and examples of normal microbiota • Beneficial roles (e.g., vitamin synthesis, protection) • Opportunistic pathogens • Concept of pathogenicity and virulence **4. Microbial Taxonomy** • Classification hierarchy: domain, kingdom, phylum, class, order, family, genus, species • Nomenclature (binomial system) • Basis of classification: morphology, genetics, biochemical traits	
III	**Morphology and Structure of Bacteria** **1. Size, Shape, and Arrangement** • Shapes: cocci, bacilli, spirilla, vibrios • Arrangements: chains, clusters, pairs • Importance in identification **2. Structure of Bacterial Cell** • Cell wall: composition and function • Cytoplasmic membrane: transport and metabolism • Capsule: role in virulence • Flagella: motility • Pili/fimbriae: adhesion and conjugation • Endospores: resistance and survival **3. Gram-Positive vs Gram-Negative Bacteria** • Differences in cell wall structure • Gram staining principle • Clinical significance (antibiotic sensitivity, pathogenicity)	8
IV	**Growth, Nutrition, and Metabolism** **1. Nutritional Requirements** • Macronutrients and micronutrients • Energy sources: autotrophs vs heterotrophs • Oxygen requirements: aerobic, anaerobic, facultative **2. Bacterial Growth Curve** • Phases: lag, log (exponential), stationary, death • Generation time and its importance **3. Culture Media** • Types: ○ Simple, enriched, selective, differential media • Examples: nutrient agar, blood agar, MacConkey agar • Uses in isolation and identification	8

Unit	Topic	Hours
	4. Environmental Factors • Temperature (psychrophiles, mesophiles, thermophiles) • pH and osmotic pressure • Moisture and light • Effect of oxygen	

V	**Sterilization and Disinfection**
	1. Physical Methods
	• Heat:
	  ○ Dry heat (hot air oven)
	  ○ Moist heat (autoclave)
	• Radiation: UV and ionizing radiation
	• Filtration: membrane filters
	2. Chemical Methods
	• Disinfectants (phenols, halogens, alcohols)
	• Antiseptics and their applications
	• Factors affecting disinfectant activity
	3. Sterilization Equipment
	• Autoclave: principle, operation, indicators
	• Hot air oven: uses and limitations
	4. Infection Control Practices
	• Hospital-acquired infections (HAIs)
	• Standard precautions
	Biomedical waste management
		6

VI	**Immunology – Basic Concepts** **1. Types of Immunity** • Innate immunity: barriers, phagocytosis, inflammation • Adaptive immunity: humoral and cell-mediated **2. Antigens and Antibodies** • Definition and types of antigens • Structure and classes of antibodies (IgG, IgM, etc.) **3. Immune Response** • Primary and secondary immune response • Antigen-antibody reactions (basic concept) **4. Hypersensitivity and Immunization** • Types of hypersensitivity (I–IV overview) • Active and passive immunity • Vaccines and immunization programs	8

Unit	Topic	Hours
VII	**Systematic Bacteriology** **1. Overview of Medically Important Bacteria** • Classification based on morphology and staining • Clinical relevance **2. Cocci** • Staphylococcus aureus: morphology, diseases • Streptococcus pyogenes: morphology, diseases **3. Bacilli** • Escherichia coli: normal flora and pathogenic strains • Salmonella typhi: typhoid fever **4. Mycobacteria** • Mycobacterium tuberculosis: tuberculosis • Acid-fast properties and significance	8
VIII	**Virology, Mycology, and Parasitology (6 Hours)** **1. Virology** • Structure: nucleic acid, capsid, envelope • Classification (DNA vs RNA viruses) • Examples: influenza virus, HIV (basic overview) **2. Mycology** • Types: yeasts and molds • Structure and reproduction • Common fungal infections (candidiasis, dermatophytosis) **3. Parasitology** • Protozoa: amoeba, malaria parasite • Helminths: roundworms, tapeworms Life cycles and transmission (basic concepts)	6
IX	**Laboratory Diagnosis of Infectious Diseases** **1. Specimen Collection and Transport** • Types of specimens: blood, urine, sputum, stool • Aseptic collection techniques • Transport media and storage **2. Microscopy and Staining** • Light microscopy • Gram staining • Acid-fast staining (Ziehl-Neelsen) **3. Culture and Sensitivity Testing** • Isolation of organisms • Antibiotic susceptibility testing (disc diffusion method – concept) • Importance in treatment decisions	4

Suggested Reading:

- Ananthanarayan and Paniker's Textbook of Microbiology, Arora, D. R., & Arora, B. (2020). *Ananthanarayan and Paniker's textbook of microbiology* (11th ed.). Universities Press.
- Jawetz Melnick and Adelberg Medical Microbiology, Carroll, K. C., Pfaller, M. A., Landry, M. L., et al. (2019). *Jawetz, Melnick, & Adelberg's medical microbiology* (28th ed.). McGraw-Hill.
- Prescott's Microbiology, Willey, J., Sherwood, L., & Woolverton, C. (2020). *Prescott's microbiology* (11th ed.). McGraw-Hill.
- District Laboratory Practice in Tropical Countries, Cheesbrough, M. (2018). *District laboratory practice in tropical countries* (2nd ed.). Cambridge University Press.
- Textbook of Microbiology, Chakraborty, P. (2017). *Textbook of microbiology*. New Central Book Agency.

Course Name: Urine and Body Fluids Analysis

Credit= 4 (60 hours)

Course Rationale:

Urine and body fluid analysis is a fundamental component of clinical laboratory diagnostics, providing valuable insights into renal function, metabolic disorders, infections, and systemic diseases. For DMLT students, a strong theoretical understanding of the physical, chemical, and microscopic examination of urine and other body fluids is essential for accurate interpretation of laboratory findings. This course equips students with the knowledge required to support clinicians in diagnosis, monitoring, and prognosis of various pathological conditions.

Learning Objective:

By the end of this course, students will be able to:

1. Understand the formation and composition of urine and body fluids.
2. Describe physical, chemical, and microscopic examination of urine.
3. Identify abnormal constituents and correlate them with diseases.
4. Explain analysis of various body fluids (CSF, pleural, peritoneal, synovial, etc.).
5. Understand laboratory techniques and instrumentation used in fluid analysis.
6. Interpret laboratory findings in clinical conditions.
7. Apply quality control and safety practices in fluid analysis.

Unit	Topic	Hours

I	**Unit I: Introduction to Urine and Body Fluids (6 Hours)**
	1. Formation of Urine (Renal Physiology Overview)
	• Structure of nephron: glomerulus, tubules, loop of Henle
	• Processes:
	  ○ Glomerular filtration
	  ○ Tubular reabsorption (water, glucose, electrolytes)
	  ○ Tubular secretion (H^+, K^+, drugs)
	• Hormonal regulation: ADH, aldosterone
	2. Composition of Normal Urine
	• Water (~95%) and solutes (~5%)
	• Organic: urea, creatinine, uric acid
	• Inorganic: sodium, potassium, chloride
	• Normal ranges and variations
	3. Types of Body Fluids
	• CSF, pleural, peritoneal, synovial, amniotic fluid
	• Origin, function, and clinical importance
	4. Importance in Clinical Diagnosis
	• Early detection of renal diseases
	• Diagnosis of metabolic disorders (diabetes, liver disease)
	• Infection detection
	• Monitoring disease progression
		6

II	**Physical Examination of Urine**
	1. Volume
	• Normal: 600–2000 mL/day
	• Polyuria, oliguria, anuria and causes
	2. Color
	• Pale yellow (urochrome pigment)
	• Abnormal colors:
	  ○ Red: hematuria
	  ○ Dark yellow: dehydration
	  ○ Brown/black: liver disorders
	3. Odor
	• Normal: aromatic
	• Fruity: ketonuria (diabetes)
	• Foul: infection
	4. Appearance
	• Clear vs cloudy
	• Causes of turbidity: cells, bacteria, crystals
		6

Unit	Topic	Hours
	5. Specific Gravity (ELABORATED) **Definition:** Specific gravity (SG) is the ratio of the density of urine to the density of distilled water. **Normal Range:** 1.003 – 1.030 **Principle** • Reflects concentration of dissolved substances (urea, salts, glucose, proteins) • Indicates kidney's concentrating and diluting ability **Methods of Measurement** • Urinometer • Refractometer (more accurate) • Reagent strip (dipstick method) **Clinical Significance** **High Specific Gravity (>1.030):** • Dehydration • Glycosuria (e.g., Diabetes Mellitus) • Proteinuria • Reduced fluid intake **Low Specific Gravity (<1.005):** • Overhydration • Renal failure • Diabetes Insipidus **Fixed Specific Gravity (~1.010):** • Seen in chronic renal failure (loss of concentrating ability) **Factors Affecting SG** • Fluid intake • Temperature • Presence of abnormal solutes **6. Turbidity and Clarity** • Transparent vs turbid • Causes: phosphates, urates, pus, bacteria **7. Clinical Significance of Physical Findings** • Early indication of disease • Guides further chemical and microscopic analysis	

Unit	Topic	Hours

III	**Chemical Examination of Urine**
	1. Proteinuria
	• Types:
	  ○ Functional (temporary)
	  ○ Glomerular
	  ○ Tubular
	• Clinical significance: kidney disease
	2. Glucosuria
	• Causes:
	  ○ Diabetes Mellitus
	  ○ Renal glycosuria
	• Threshold concept
	3. Ketone Bodies
	• Types: acetone, acetoacetate, β-hydroxybutyrate
	• Seen in starvation, uncontrolled diabetes
	4. Bilirubin and Urobilinogen
	• Liver function indicators
	• Increased in jaundice and liver disease
	5. Hematuria vs Hemoglobinuria
	• Hematuria: intact RBCs
	• Hemoglobinuria: free hemoglobin
	• Causes: infection, trauma, hemolysis
	6. Urine pH
	• Normal: 4.5 – 8.0
	• Acidic urine: acidosis, high protein diet
	• Alkaline urine: infections, vegetarian diet
	7. Reagent Strip (Dipstick) Testing
	• Principle: color change reactions
	• Parameters: protein, glucose, ketones, pH, blood
	• Advantages: rapid, screening tool
	• Limitations: false positives/negatives
		10

IV	**Microscopic Examination of Urine** **1. Urinary Sediments** **Cells** • RBCs: glomerular damage • WBCs: infection/inflammation • Epithelial cells: contamination or pathology	8

Unit	Topic	Hours
	Casts • Hyaline: normal or mild disease • Granular: renal disease • RBC casts: glomerulonephritis • WBC casts: infection **Crystals** • Uric acid: gout • Calcium oxalate: kidney stones • Triple phosphate: alkaline urine **Microorganisms** • Bacteria: urinary tract infection • Yeast: fungal infection • Parasites (e.g., Trichomonas) **2. Clinical Significance** • Helps confirm diagnosis • Differentiates types of renal and urinary disorders	
V	**Renal Function Tests** **1. Blood Urea and Creatinine** • Indicators of kidney function • Elevated levels in renal impairment **2. Clearance Tests** • Urea clearance • Creatinine clearance (more reliable) **3. Glomerular Filtration Rate (GFR)** • Measure of kidney function • Estimation methods (basic concept) **4. Interpretation** • Acute vs chronic kidney disease • Correlation with urine findings	6
VI	**Cerebrospinal Fluid (CSF) Analysis (6 Hours)** **1. Formation and Function** • Produced in choroid plexus • Functions: cushioning, nutrient transport **2. Collection and Handling** • Lumbar puncture • Sterile technique and precautions **3. Examination** • Physical: color, clarity • Chemical: protein, glucose • Microscopic: cells, organisms	6

Unit	Topic	Hours
	4. Clinical Findings • Bacterial meningitis: ↑ protein, ↓ glucose, neutrophils • Viral meningitis: normal glucose, lymphocytes	

VII	**Analysis of Other Body Fluids**
	1. Pleural and Peritoneal Fluids
	• Transudate vs exudate:
	  ○ Transudate: low protein (e.g., heart failure)
	  ○ Exudate: high protein (e.g., infection)
	• Light's criteria (basic concept)
	• Cytology: malignant cells
	2. Synovial Fluid
	• Normal: clear, viscous
	• In arthritis:
	  ○ Rheumatoid arthritis: inflammatory
	  ○ Gout: uric acid crystals
	3. Amniotic Fluid
	• Role in fetal protection and development
	• Clinical significance:
	  ○ Fetal abnormalities
	  ○ Lung maturity (basic concept)
		10

VIII	**Laboratory Techniques and Instrumentation** **1. Urine Analyzers** • Automated dipstick readers • Advantages: speed, standardization **2. Centrifugation** • Sediment preparation • Speed and time considerations **3. Reagent Strips** • Principle of chemical reactions • Interpretation of results **4. Quality Control** • Internal controls • Calibration of instruments	4
IX	**Safety, Quality Control, and Clinical Correlation (4 Hours)** **1. Biosafety Precautions** • Handling infectious samples • Use of PPE • Spill management	4

Unit	Topic	Hours
	2. Quality Control • Internal QC (daily checks) • External QC (proficiency testing) **3. Sources of Error** • Pre-analytical: improper collection • Analytical: instrument error • Post-analytical: reporting mistakes **4. Clinical Correlation** • Integrating urine findings with patient condition • Case-based interpretation • Importance in diagnosis and treatment monitoring	

Suggested Reading:

- Clinical Diagnosis and Management by Laboratory Methods McPherson, R. A., & Pincus, M. R. (2022). *Henry's clinical diagnosis and management by laboratory methods* (24th ed.). Elsevier.
- Urinalysis and Body Fluids, Strasinger, S. K., & Di Lorenzo, M. S. (2020). *Urinalysis and body fluids* (7th ed.). F.A. Davis.
- Textbook of Medical Laboratory Technology, Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vols. 1–3). Tata McGraw-Hill.
- Clinical Biochemistry, Satyanarayana, U., & Chakrapani, U. (2021). *Biochemistry* (6th ed.). Elsevier.
- Practical Clinical Biochemistry, Varley, H., Gowenlock, A. H., & Bell, M. (2018). *Varley's practical clinical biochemistry* (6th ed.). CBS Publishers.

Course Name: Introduction to Haematology

Credit= 3 (45 hours)

Course Rationale:

Haematology is a core discipline in medical laboratory science that focuses on the study of blood, blood-forming organs, and related disorders. Laboratory evaluation of blood plays a crucial role in diagnosing conditions such as anaemia, infections, bleeding disorders, and haematological malignancies. This course provides DMLT students with fundamental knowledge of blood cell morphology, haematopoiesis, haemostasis, and basic laboratory investigations, enabling them to contribute effectively to clinical diagnosis and patient management.

Learning Objective:

By the end of this course, students will be able to:

1. Understand the composition and functions of blood.
2. Describe hematopoiesis and development of blood cells.
3. Identify normal and abnormal blood cell morphology.
4. Explain principles of hematological investigations.
5. Understand basic concepts of anemia, leukocyte disorders, and bleeding disorders.
6. Describe mechanisms of hemostasis and coagulation.
7. Interpret basic hematological laboratory findings.
8. Apply quality control and safety in hematology laboratories.

Unit	Topic	Hours

I	**Introduction to Hematology**
	1. Definition and Scope
	• Hematology is the study of blood, blood-forming organs, and blood-related diseases.
	• Scope includes:
	  ○ Diagnosis of blood disorders
	  ○ Monitoring disease progression
	  ○ Transfusion medicine
	  ○ Research and preventive healthcare
	2. Composition of Blood
	• **Plasma (55%)**
	  ○ Water (90–92%)
	  ○ Proteins:
	  ▪ Albumin (maintains osmotic pressure)
	  ▪ Globulin (immunity)
	  ▪ Fibrinogen (clotting)
	• **Formed Elements (45%)**
	  ○ RBCs (erythrocytes): oxygen transport
	  ○ WBCs (leukocytes): immune defense
	  ○ Platelets (thrombocytes): hemostasis
	3. Functions of Blood
	• Transport: oxygen, nutrients, hormones
	• Protection: immune response, clotting
	• Regulation: pH, temperature, fluid balance
	4. Hematopoietic System
	• Bone marrow: primary site of blood cell production
	• Lymphoid organs: spleen, lymph nodes, thymus
	• Role in production, maturation, and destruction of cells
	5. Clinical Importance
	• Diagnosis of anemia, infections, leukemia
	• Monitoring chemotherapy and transfusion
	• Early disease detection and prognosis
		4

II	**Hematopoiesis** **1. Sites of Hematopoiesis** • Embryonic: yolk sac • Fetal: liver and spleen • Adult: red bone marrow (sternum, ribs, vertebrae)	6

Unit	Topic	Hours

	2. Hematopoietic Stem Cells (HSCs)
	• Multipotent, self-renewing cells
	• Differentiate into:
	  ○ Myeloid lineage → RBCs, platelets, granulocytes
	  ○ Lymphoid lineage → lymphocytes
	3. Blood Cell Formation
	• **Erythropoiesis**
	  ○ Proerythroblast → reticulocyte → RBC
	• **Leukopoiesis**
	  ○ Granulocytes and agranulocytes formation
	• **Thrombopoiesis**
	  ○ Platelets from megakaryocytes
	4. Role of Growth Factors
	• Erythropoietin (kidney): RBC production
	• Colony-stimulating factors (CSFs): WBC production
	• Interleukins: immune regulation	

III	**Erythrocytes and Hemoglobin (6 Hours)**
	1. RBC Structure and Function
	• Biconcave, flexible, no nucleus
	• High surface area for gas exchange
	• Lifespan: ~120 days
	2. Hemoglobin
	• Structure: heme (iron-containing) + globin chains
	• Types:
	  ○ HbA (adult)
	  ○ HbF (fetal, higher oxygen affinity)
	  ○ HbS (abnormal, sickle cell – basic concept)
	3. RBC Indices
	• MCV: indicates cell size
	• MCH: amount of Hb per cell
	• MCHC: Hb concentration in RBC
	4. Anemia
	• Definition: decreased Hb concentration
	• Classification:
	  ○ Microcytic (iron deficiency)
	  ○ Macrocytic (vitamin B12/folate deficiency)
	  ○ Normocytic (chronic disease)
		6

Unit	Topic	Hours
IV	**Leukocytes** **1. Types and Morphology** • Neutrophils: multilobed nucleus, phagocytosis • Eosinophils: allergic response, parasitic defense • Basophils: histamine release • Lymphocytes: B and T cells (immunity) • Monocytes: differentiate into macrophages **2. Functions** • Defense against infection • Inflammatory response • Antibody production **3. Leukocyte Disorders** • **Leukocytosis**: increased WBC count • **Leukopenia**: decreased WBC count **4. Leukemia** • Malignant proliferation of WBCs • Types: ○ Acute (rapid onset) ○ Chronic (slow progression) Clinical features: anemia, infections, bleeding	6
V	**Platelets and Hemostasis (6 Hours)** **1. Platelet Structure and Function** • Small, anucleate fragments from megakaryocytes • Role in clot formation and vessel repair **2. Hemostasis Mechanism** **Primary Hemostasis** • Vasoconstriction • Platelet adhesion (via von Willebrand factor) • Platelet aggregation → platelet plug **Secondary Hemostasis** • Activation of clotting factors • Formation of fibrin clot **3. Coagulation Cascade (Overview)** • Intrinsic pathway • Extrinsic pathway • Common pathway → fibrin formation	6

Unit	Topic	Hours

	4. Bleeding Disorders
	• Hemophilia:
	  ○ Factor VIII deficiency
	  ○ Prolonged bleeding, joint hemorrhage
	• Thrombocytopenia:
	  ○ Low platelet count
	  ○ Petechiae, bruising	

VI	**Hematological Investigations (7 Hours)** **1. Complete Blood Count (CBC)** • RBC, WBC, platelet count • Hemoglobin concentration • Differential leukocyte count **2. Hemoglobin Estimation** • Sahli's method • Cyanmethemoglobin method (standard method) **3. Packed Cell Volume (PCV)** • Percentage of RBC volume • Measured using centrifugation **4. Erythrocyte Sedimentation Rate (ESR)** • Rate of RBC settling • Indicator of inflammation **5. Peripheral Blood Smear** • Preparation, staining (Leishman stain) • Morphological evaluation **6. Coagulation Tests** • Bleeding Time (BT): platelet function • Clotting Time (CT): coagulation Prothrombin Time (PT): extrinsic pathway	7
VII	**Blood Groups and Transfusion** **1. ABO Blood Group System** • Antigens (A, B) and antibodies • Compatibility and transfusion rules **2. Rh Typing** • Rh-positive and Rh-negative • Importance in pregnancy (HDN concept) **3. Blood Transfusion** • Indications: anemia, surgery, trauma • Donor screening and safety	5

Unit	Topic	Hours
	4. Cross-Matching • Ensures donor-recipient compatibility • Prevents adverse reactions **5. Transfusion Reactions** • Acute hemolytic reaction • Febrile non-hemolytic reaction • Allergic reactions	
VIII	**Hematological Disorders** **1. Anemia** **Iron Deficiency Anemia** • Causes: poor diet, chronic blood loss • Features: microcytic, hypochromic RBCs **Megaloblastic Anemia** • Causes: vitamin B12/folate deficiency • Features: macrocytic RBCs **2. Leukemia** • **Acute Leukemia**: rapid progression, immature cells • **Chronic Leukemia**: slow progression, mature cells • Types: myeloid and lymphoid **3. Bleeding Disorders** **Hemophilia** • X-linked inherited disorder • Factor deficiency → prolonged bleeding **Thrombocytopenia** • Low platelet count • Symptoms: petechiae, mucosal bleeding **Disseminated Intravascular Coagulation (DIC)** • Widespread clotting followed by bleeding • Causes: sepsis, trauma • Lab findings: prolonged PT, decreased platelets	5

Suggested Reading:

- Dacie and Lewis Practical Haematology, Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2021). *Dacie and Lewis practical haematology* (13th ed.). Elsevier.
- Essential Haematology, Hoffbrand, A. V., & Moss, P. A. H. (2019). *Essential haematology* (7th ed.). Wiley-Blackwell.
- Textbook of Medical Laboratory Technology, Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vols. 1–3). Tata McGraw-Hill.
- Clinical Hematology Principles Procedures Correlations, Rodak, B. F., Carr, J. H., & Doig, K. (2020). *Clinical hematology: Principles, procedures, and correlations* (6th ed.). Elsevier.
- Textbook of Hematology, Chatterjee, C. C. (2018). *Human physiology (Vol. on blood)*. Medical Allied Agency.

Course Name: Basics of Blood Banking

Credit= 3 (45 hours)

Course Rationale:

Blood banking is a critical component of healthcare systems, ensuring the safe collection, processing, storage, and distribution of blood and its components. Medical laboratory professionals play a key role in maintaining the quality and safety of blood transfusion services. This course provides DMLT students with foundational knowledge of blood group systems, donor selection, blood collection, compatibility testing, and transfusion practices, enabling them to contribute effectively to blood bank operations and patient care.

Learning Objective:

By the end of this course, students will be able to:

1. Understand the principles and organization of blood banking services.
2. Describe blood group systems and compatibility principles.
3. Explain donor selection, blood collection, and storage procedures.
4. Understand component preparation and their clinical uses.
5. Perform and interpret compatibility testing concepts.
6. Recognize transfusion reactions and their management.
7. Apply quality control and safety practices in blood banking.

Unit	Topic	Hours

I	**Unit I: Introduction to Blood Banking**
	1. Definition and Scope
	• Blood banking: collection, processing, testing, storage, and distribution of blood and its components
	• Scope includes:
	  ○ Transfusion services
	  ○ Component preparation
	  ○ Screening for infections
	  ○ Quality assurance and regulatory compliance
	2. Organization and Functions of a Blood Bank
	• Sections:
	  ○ Donor area
	  ○ Collection and processing unit
	  ○ Testing laboratory
	  ○ Storage and issue section
	• Functions:
	  ○ Blood collection and processing
	  ○ Compatibility testing
	  ○ Component preparation
	  ○ Record maintenance
	3. Role in Healthcare System
	• Emergency services (trauma, surgery)
	• Management of anemia and bleeding disorders
	• Support in obstetrics and oncology
	• Role in public health programs
	4. Regulatory Guidelines and Ethics
	• National and international guidelines (e.g., NACO, WHO – overview)
	• Ethical principles:
	  ○ Voluntary donation
	  ○ Confidentiality
	  ○ Informed consent
	• Avoidance of commercial blood donation
		4

II	**Blood Group Systems** **1. ABO Blood Group System** • Antigens: A, B on RBC surface • Antibodies: anti-A, anti-B in plasma • Blood groups: A, B, AB, O • Landsteiner's law (basic concept)	6

Unit	Topic	Hours

	2. Rh Blood Group System
	• Rh factor (D antigen)
	• Rh-positive vs Rh-negative
	• Clinical importance:
	  ○ Hemolytic disease of newborn (HDN)
	  ○ Transfusion compatibility
	3. Other Minor Blood Group Systems
	• Kell, Duffy, Kidd (basic overview)
	• Importance in transfusion reactions
	4. Clinical Importance
	• Safe blood transfusion
	• Prevention of hemolytic reactions
	• Role in antenatal screening	

III	**Unit III: Blood Donation and Donor Selection** **1. Types of Donors** • Voluntary donor (preferred) • Replacement donor • Autologous donor **2. Donor Selection Criteria** • Age: typically 18–65 years • Weight: ≥45–50 kg • Hemoglobin level: ≥12.5 g/dL • General health status **3. Pre-Donation Screening and Counseling** • Medical history • Physical examination (pulse, BP, Hb) • Counseling regarding procedure and risks **4. Donor Deferral** • Temporary deferral: infection, recent surgery • Permanent deferral: chronic diseases, high-risk behavior **5. Adverse Reactions in Donors** • Vasovagal reaction (fainting) • Hematoma formation • Management and prevention	6
IV	**Blood Collection and Storage (6 Hours)** **1. Blood Collection** • Aseptic technique • Use of anticoagulants (CPDA, EDTA – basic idea) • Standard blood collection volume (350–450 mL)	6

Unit	Topic	Hours
	2. Blood Bags • Single, double, triple, quadruple bags • Use in component separation **3. Storage Conditions** • Whole blood: 2–6°C • Platelets: 20–24°C with agitation • Plasma: frozen at −30°C **4. Shelf Life** • RBCs: 35–42 days • Platelets: 5–7 days • Plasma: up to 1 year **5. Transportation** • Cold chain maintenance • Avoid hemolysis and contamination	
V	**Blood Components and Their Uses** **1. Whole Blood vs Component Therapy** • Whole blood: rarely used • Component therapy: specific treatment, reduces complications **2. Blood Components** **Packed Red Cells (PRBCs)** • Used in anemia and blood loss **Platelet Concentrates** • Used in thrombocytopenia **Fresh Frozen Plasma (FFP)** • Contains clotting factors • Used in coagulation disorders **Cryoprecipitate** • Rich in fibrinogen and factor VIII • Used in bleeding disorders **3. Clinical Applications** • Targeted therapy improves patient outcomes • Minimizes volume overload	6
VI	**Compatibility Testing (Cross-Matching)** **1. Principles** • Ensures donor-recipient compatibility • Prevents antigen-antibody reactions **2. Cross-Matching** • **Major cross-match**: donor RBC + recipient serum • **Minor cross-match**: donor serum + recipient RBC	6

Unit	Topic	Hours
	3. Antiglobulin (Coombs) Test • Detects incomplete antibodies • Direct and indirect tests (basic concept) **4. Clinical Importance** • Prevents transfusion reactions • Ensures safe transfusion practices	
VII	**Transfusion Practices and Reactions** **1. Indications** • Severe anemia • Blood loss (trauma, surgery) • Coagulation disorders **2. Administration and Monitoring** • Pre-transfusion checks • Vital signs monitoring • Slow initial infusion **3. Transfusion Reactions** **Acute Hemolytic Reaction** • Due to ABO incompatibility • Symptoms: fever, chills, hemoglobinuria **Febrile Non-Hemolytic Reaction** • Due to leukocyte antibodies • Mild fever and discomfort **Allergic Reaction** • Rash, itching, anaphylaxis (rare) **4. Prevention and Management** • Proper cross-matching • Immediate stoppage of transfusion if reaction occurs • Supportive treatment	5
VIII	**Quality Control and Safety in Blood Banking** **1. Quality Assurance** • Standard operating procedures (SOPs) • Equipment calibration and maintenance **2. Screening for Transfusion-Transmitted Infections (TTIs)** • HIV, Hepatitis B, Hepatitis C, syphilis, malaria • Importance of safe blood supply **3. Safety Protocols** • Use of PPE • Sterile techniques • Biomedical waste disposal	4

Unit	Topic	Hours
	4. Documentation • Donor records • Testing reports Traceability of blood units	
IX	**Blood Bank Management and Ethics (2 Hours)** **1. Inventory Management** • Stock maintenance • Avoiding shortage and wastage • FIFO (First In First Out) principle **2. Legal and Ethical Issues** • Informed consent • Confidentiality of donor and recipient • Prohibition of paid donation **3. National Policies and Programs** • Promotion of voluntary blood donation • Awareness campaigns • Role of government and organizations	2

Suggested Reading:

- Mollison's Blood Transfusion in Clinical Medicine, Klein, H. G., & Anstee, D. J. (2020). *Mollison's blood transfusion in clinical medicine* (13th ed.). Wiley-Blackwell.
- Practical Transfusion Medicine, Murphy, M. F., & Pamphilon, D. H. (2017). *Practical transfusion medicine* (5th ed.). Wiley-Blackwell.
- Textbook of Blood Banking and Transfusion Medicine, Saran, R. K. (2019). *Transfusion medicine and blood banking* (2nd ed.). Jaypee Brothers.
- Technical Manual, American Association of Blood Banks. (2020). *AABB technical manual* (20th ed.). AABB.
- Textbook of Medical Laboratory Technology, Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vols. 1–3). Tata McGraw-Hill.

Course Name: Microbiology Practicals

Credit= 2 (60 hours)

Course Rationale:

Practical training in microbiology is essential for developing the technical skills required in diagnostic laboratories. This course provides hands-on experience in specimen handling, microscopy, culture techniques, sterilization, and identification of microorganisms. It enables DMLT students to perform routine microbiological investigations accurately, maintain aseptic conditions, and ensure laboratory safety, which are critical for diagnosis and infection control.

Learning Objective:

By the end of this course, students will be able to:

1. Demonstrate proper laboratory safety and aseptic techniques.
2. Perform collection, transport, and processing of clinical specimens.
3. Prepare and use culture media for microbial growth.
4. Perform staining techniques for identification of microorganisms.
5. Use microscopes effectively for microbial observation.
6. Isolate and identify common bacteria using basic laboratory methods.
7. Perform antimicrobial susceptibility testing.
8. Maintain quality control and proper documentation in microbiology labs.

S. No.	Practical	Hours
1	Laboratory safety, PPE, and biosafety practices	2
2	Aseptic techniques (flame sterilization, handling cultures)	2
3	Disinfection and biomedical waste disposal	2
4	Study of microscope and its parts	2
5	Focusing techniques (low and high power)	2
6	Preparation and examination of wet mount	2
7	Preparation of bacterial smear	2
8	Simple staining	2
9	Gram staining (procedure and interpretation)	4
10	Ziehl-Neelsen staining (demonstration)	1
11	Lactophenol cotton blue staining (demonstration)	1
12	Preparation of culture media (agar/broth)	3
13	Autoclave operation and sterilization	3
14	Pouring of agar plates	2
15	Streak culture method	4
16	Stab culture technique	2
17	Lawn culture technique	2
18	Observation of colony morphology	2
19	Gram reaction-based identification	2
20	Catalase test	2
21	Oxidase test	2
22	Indole test (demonstration)	2
23	Kirby-Bauer antibiotic sensitivity test	4
24	Measurement and interpretation of zones	2
25	Collection and labeling of clinical specimens	2
26	Demonstration of urine/sputum processing	2
27	Laboratory record maintenance and reporting	1
28	Internal quality control procedures	1

Suggested Reading:

- Mackie & McCartney Practical Medical Microbiology, Collee, J. G., Fraser, A. G., Marmion, B. P., & Simmons, A. (2019). *Mackie & McCartney practical medical microbiology* (15th ed.). Elsevier.
- Ananthanarayan and Paniker's Textbook of Microbiology, Arora, D. R., & Arora, B. (2020). *Ananthanarayan and Paniker's textbook of microbiology* (11th ed.). Universities Press.
- Bailey and Scott's Diagnostic Microbiology, Tille, P. (2022). *Bailey & Scott's diagnostic microbiology* (15th ed.). Elsevier.
- Textbook of Medical Laboratory Technology, Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vols. 1–3). Tata McGraw-Hill.

Course Name: Urine and body Fluids Practicals

Credit= 4 (60 hours)

Course Rationale:

Analysis of urine and body fluids is a fundamental component of clinical laboratory diagnostics, providing critical information for the diagnosis and monitoring of renal, metabolic, infectious, and systemic disorders. This practical course equips DMLT students with hands-on skills in physical, chemical, and microscopic examination of urine and other body fluids, along with interpretation and quality control practices. It prepares students to perform routine laboratory investigations accurately and safely in clinical settings.

Learning Objective:

By the end of this course, students will be able to:

1. Perform physical, chemical, and microscopic examination of urine.
2. Identify normal and abnormal urinary findings.
3. Analyze body fluids such as CSF, pleural, and synovial fluids.
4. Perform basic renal function-related laboratory procedures.
5. Operate laboratory equipment used in urine and fluid analysis.
6. Apply biosafety and quality control practices.
7. Record and interpret laboratory findings accurately.

S. No.	Practical	Hours
1	Laboratory safety, PPE, and biosafety practices	2
2	Specimen collection, labeling, transport, and storage	2
3	Urine preservation techniques and waste disposal	2
4	Measurement of urine volume and physical examination	2
5	Observation of urine color, odor, appearance	2
6	Specific gravity measurement (urinometer/refractometer)	2
7	Protein detection (heat and acetic acid test)	2
8	Glucose detection (Benedictâ€™s test)	2
9	Ketone body detection	2
10	Bile pigments and bile salts detection	2
11	Occult blood detection	2
12	Urine pH measurement and dipstick analysis	2
13	Preparation of urine sediment	2
14	Microscopic identification of cells (RBCs, WBCs, epithelial)	2
15	Identification of casts	2
16	Identification of crystals	2
17	Identification of microorganisms in urine	2
18	Blood urea estimation (demonstration)	2
19	Serum creatinine estimation (demonstration)	2
20	Creatinine clearance calculation (concept)	2
21	CSF handling and physical examination	2
22	CSF chemical analysis (protein, glucose)	2
23	CSF microscopic examination	2
24	Pleural/peritoneal fluid examination	2
25	Cell count and differentiation in body fluids	2
26	Synovial fluid analysis	2
27	Amniotic fluid analysis (demonstration)	2
28	Urine analyzer operation (demonstration)	2
29	Centrifugation and sediment preparation	2
30	Quality control, reporting, and documentation	2

Suggested Reading:

- Clinical Diagnosis and Management by Laboratory Methods, McPherson, R. A., & Pincus, M. R. (2022). *Henry's clinical diagnosis and management by laboratory methods* (24th ed.). Elsevier.
- Textbook of Urinalysis and Body Fluids, Strasinger, S. K., & Di Lorenzo, M. S. (2020). *Urinalysis and body fluids* (7th ed.). F.A. Davis.
- Textbook of Medical Laboratory Technology, Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vols. 1–3). Tata McGraw-Hill.
- Clinical Chemistry Principles Techniques and Correlations, Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2018). *Clinical chemistry: Principles, techniques, and correlations* (8th ed.). Wolters Kluwer.

Course Name: Clinical Applications -2 Plebotomy, Hemeatology and Blood Banking (Supervised Lab Rotation)

Credit= 2 (60 hours)

Course Rationale:

Hematology and blood banking are core areas of diagnostic laboratory services. Accurate performance of hematological tests and safe transfusion practices are critical for patient care. This course provides hands-on training in blood examination, hematological investigations, blood grouping, and compatibility testing. It enables students to develop technical competence, analytical skills, and adherence to safety and quality standards required in clinical laboratories and blood banks.

Learning Objective:

By the end of the course, students will be able to:

1. Perform safe and effective **capillary and venous blood collection**.
2. Apply correct sample handling, anticoagulant usage, and labeling practices.
3. Prepare and examine peripheral blood smears.
4. Perform routine hematological investigations accurately.
5. Identify normal and abnormal blood cells microscopically.
6. Conduct basic coagulation tests.
7. Perform blood grouping, Rh typing, and cross-matching.
8. Follow biosafety, infection control, and quality assurance protocols.
9. Maintain proper documentation and interpret laboratory findings.

Phlebotomy Practical list:

S. No.	Practical	Hours
1	Laboratory safety, PPE, infection control practices	2
2	Patient identification and preparation	1
3	Capillary blood collection (finger prick/heel prick)	3
4	Venous blood collection (phlebotomy using vacutainer/syringe)	4
5	Anticoagulants and order of draw	1
6	Sample labeling, transport, and storage	1
Hematology Practical list:		
7	Preparation of peripheral blood smear	2
8	Staining of smear (Leishman stain)	2
9	Microscopic examination of RBC morphology	2
10	Microscopic examination of WBC morphology	2
11	Differential leukocyte count (DLC)	3
12	Total leukocyte count (TLC)	2
13	RBC count using hemocytometer	3
14	Platelet count	2
15	Hemoglobin estimation (Sahli's method)	2
16	Packed cell volume (PCV)	2
Blood Banking Practical:		
17	Erythrocyte sedimentation rate (ESR)	2
18	Calculation of RBC indices (MCV, MCH, MCHC)	2
19	Reticulocyte count (demonstration)	2
20	Identification of abnormal cells (slides)	2
21	Bleeding time (BT)	1
22	Clotting time (CT)	1

Suggested Reading:

- Dacie and Lewis Practical Haematology, Bain, B. J., Bates, I., Laffan, M. A., & Lewis, S. M. (2021). *Dacie and Lewis practical haematology* (13th ed.). Elsevier.
- Clinical Hematology Principles Procedures Correlations, Rodak, B. F., Carr, J. H., & Doig, K. (2020). *Clinical hematology: Principles, procedures, and correlations* (6th ed.). Elsevier.
- Mollison's Blood Transfusion in Clinical Medicine, Klein, H. G., & Anstee, D. J. (2020). *Mollison's blood transfusion in clinical medicine* (13th ed.). Wiley-Blackwell.
- Practical Transfusion Medicine, Murphy, M. F., & Pamphilon, D. H. (2017). *Practical transfusion medicine* (5th ed.). Wiley-Blackwell.
- Textbook of Medical Laboratory Technology, Mukherjee, K. L., & Ghosh, S. (2019). *Medical laboratory technology* (Vols. 1–3). Tata McGraw-Hill.

Course Name: Histopathology and Cytology

Credits = 4 (60 Hours)

Course Rationale:

This course provides foundational knowledge of **tissue processing, staining, and cytological examination**, enabling students to understand laboratory workflows and support diagnostic services. Emphasis is placed on **conceptual clarity, morphology, and quality practices**.

Course Objectives:

By the end of the course, the learner will be able to:

- Explain principles of **histopathology and cytology techniques**
- Describe **tissue processing and staining procedures**
- Identify **basic tissue types and cellular morphology**
- Understand **laboratory safety, quality assurance, and documentation**

Learning outcomes:

- Describe steps of tissue processing and staining
- Explain cytological techniques and applications
- Identify normal tissue structure and cell morphology
- Understand safety protocols and laboratory workflow

Unit	Topic	Hours
1	Introduction to Histopathology (5 hrs) • Definition and scope • Role in diagnosis • Types of specimens (biopsy, surgical) • Overview of laboratory workflow	5
2	Tissue Processing (10 hrs) • Fixation: purpose, types, fixatives (formalin) • Dehydration: graded alcohol • Clearing: xylene • Embedding: paraffin wax • Factors affecting tissue processing	10
3	Microtomy & Sectioning (5 hrs) • Principles of section cutting • Types of microtomes (overview) • Thickness and quality of sections • Common errors in sectioning	5

4	Staining Techniques (10 hrs)
	• Principles of staining
	• Hematoxylin & Eosin (H&E) staining
	• Overview of special stains:
	  ○ PAS
	  ○ Ziehl-Neelsen (correlation)
	• Mounting and labeling
		10

5	Microscopy & Tissue Identification (8 hrs)
	• Types of microscopes
	• Principles of light microscopy
	• Identification of basic tissues:
	  ○ Epithelium
	  ○ Connective tissue
	  ○ Muscle
	  ○ Nervous tissue
		8

6	Introduction to Cytology (8 hrs)
	• Definition and importance
	• Types:
	  ○ Exfoliative cytology
	  ○ FNAC (concept)
	• Smear preparation (principles)
	• Fixation and staining (overview)
		8

Unit	Topic	Hours
7	Cellular Morphology (6 hrs) • Structure of a cell • Nuclear and cytoplasmic features • Differences between normal and abnormal cells • Introductory concept of malignancy	6
8	Laboratory Safety & Quality Assurance (5 hrs) • Biosafety practices • Chemical hazards (formalin, xylene) • Waste disposal • Quality assurance basics	5
9	Documentation, Errors & Ethics (3 hrs) • Labeling and identification errors • Record keeping • Ethical practices and confidentiality	3
Total		**60**

Suggested Readings:

- Techniques in Histopathology and Cytology: A Guide for Medical Laboratory Technology by Apurba Sankar Sastry/Jaypee
- Histopathology and Cytopathology for Medial Laboratory Technology by Pooja Meena and Premsukh Mehta (Manish Publications)
- Histopathology Techniques and its Management by Ramadas Nayak
- Basic and Advanced Laboratory Techniques in Histopathology and Cytology by Pranab Dey

Course Name: Applications of Microbiology

Credit= 3 (45 hours)

Course Rationale:

Microbiology II builds on foundational microbiology and focuses on clinically important microorganisms and their laboratory diagnosis. This course equips DMLT students with knowledge of pathogenic bacteria, viruses, fungi, and parasites, along with diagnostic techniques, antimicrobial susceptibility testing, and infection control practices. It emphasizes the role of the laboratory in identifying infectious agents and guiding appropriate treatment, which is essential for effective patient care and public health.

Learning Objective:

By the end of this course, the student will be able to:

1. Classify and describe clinically important microorganisms.
2. Understand pathogenesis and laboratory diagnosis of infectious diseases.
3. Explain diagnostic microbiological techniques and their interpretation.
4. Perform basic identification strategies for bacteria, fungi, parasites, and viruses (theory-based).
5. Understand antimicrobial agents and susceptibility testing.
6. Apply infection control and biosafety principles in the laboratory.

Unit	Topic	Hours
I	**Systematic Bacteriology I:** Morphology, cultural characteristics, pathogenicity, and laboratory diagnosis of Gram-positive bacteria (Staphylococcus, Streptococcus, Bacillus, Clostridium, Corynebacterium)	8
II	**Systematic Bacteriology II:** Gram-negative bacteria (Enterobacteriaceae, Pseudomonas, Vibrio, Neisseria, Haemophilus); specimen collection and identification methods	8
III	**Virology:** General properties of viruses, structure, classification, replication; laboratory diagnosis of viral infections (HIV, hepatitis viruses, dengue, influenza)	6
IV	**Mycology:** Classification of fungi, morphology, culture methods; laboratory diagnosis of fungal infections (Candida, Aspergillus, dermatophytes)	6
V	**Parasitology:** Classification of parasites; morphology, life cycle, and laboratory diagnosis of protozoa (Entamoeba, Plasmodium) and helminths	6
VI	**Antimicrobial Agents & Susceptibility Testing:** Types of antimicrobial agents, mechanisms of action, antimicrobial resistance; methods of susceptibility testing (Kirby-Bauer, MIC)	5
VII	**Infection Control & Biosafety:** Hospital-acquired infections, sterilization and disinfection methods, biomedical waste management, biosafety levels and precautions	6
Total		**45**

Suggested Reading

1. Ananthanarayan, R., & Paniker, C. K. J. (2017). *Textbook of Microbiology* (10th ed.). Universities Press.
2. Cheesbrough, M. (2010). *District Laboratory Practice in Tropical Countries* (2nd ed.). Cambridge University Press.
3. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2021). *Medical Microbiology* (9th ed.). Elsevier.
4. Collee, J. G., Fraser, A. G., Marmion, B. P., & Simmons, A. (2014). *Mackie and McCartney Practical Medical Microbiology* (14th ed.). Churchill Livingstone.
5. Parija, S. C. (2016). *Textbook of Medical Parasitology* (5th ed.). Elsevier.

Course Name: Applications of Hematology

Credit= 3 (45 hours)

Course Rationale:

Hematology II advances the foundational knowledge of blood and its disorders, focusing on the pathophysiology, laboratory diagnosis, and interpretation of hematological diseases. This course equips DMLT students with essential understanding of anemias, leukemias, bleeding and clotting disorders, and advanced diagnostic techniques. It emphasizes the critical role of laboratory investigations in disease diagnosis, monitoring, and management.

Learning Objective:

By the end of this course, the student will be able to:

1. Classify and describe various hematological disorders.
2. Understand the pathophysiology of anemia, leukemias, and bleeding disorders.
3. Interpret hematological laboratory investigations and reports.
4. Explain principles of coagulation and hemostasis testing.
5. Understand advanced hematological diagnostic techniques.
6. Apply quality control and safety in hematology laboratories.

Unit	Topic	Hours
I	**Anemias:** Classification (microcytic, macrocytic, normocytic), iron deficiency anemia, megaloblastic anemia, hemolytic anemia; laboratory diagnosis and interpretation	8
II	**Leukocyte Disorders:** Leukocytosis, leukopenia; leukemias (acute and chronic), basic classification and laboratory findings; lymphoma (overview)	7
III	**Platelet Disorders:** Thrombocytopenia, thrombocytosis; qualitative platelet disorders; laboratory evaluation of platelet function	6
IV	**Hemostasis and Coagulation:** Mechanism of coagulation, clotting factors, intrinsic and extrinsic pathways; bleeding disorders (hemophilia, DIC); coagulation tests (PT, aPTT, BT, CT)	8
V	**Hemoglobinopathies:** Thalassemia, sickle cell anemia; structure and function of hemoglobin; screening and diagnostic tests	6
VI	**Blood Cell Morphology & Special Tests:** Peripheral smear examination, RBC inclusions, WBC abnormalities; ESR, reticulocyte count, bone marrow examination (basic concepts)	5
VII	**Quality Control & Automation in Hematology:** Automated hematology analyzers, principles, parameters (CBC), quality control, sources of error, laboratory safety	5
Total		**45**

Suggested Reading:

1. Turgeon, M. L. (2022). *Clinical Hematology: Theory and Procedures* (6th ed.). Wolters Kluwer.
2. Bain, B. J. (2015). *Blood Cells: A Practical Guide* (5th ed.). Wiley-Blackwell.
3. Rodak, B. F., Fritsma, G. A., & Keohane, E. M. (2020). *Hematology: Clinical Principles and Applications* (6th ed.). Elsevier.
4. Dacie, J. V., & Lewis, S. M. (2016). *Practical Haematology* (12th ed.). Elsevier.
5. McKenzie, S. B., & Williams, J. L. (2019). *Clinical Laboratory Hematology* (3rd ed.). Pearson.

Course Name: Advanced Skills in Blood Banking

Credit= 4 (60 hours)

Course Rationale:

Blood banking is a critical component of transfusion medicine and patient care. This course provides advanced knowledge of blood group systems, compatibility testing, component preparation, transfusion practices, and quality assurance. It prepares DMLT students to handle real-world blood bank operations, ensuring safe transfusion practices, prevention of transfusion reactions, and adherence to regulatory and biosafety standards.

Learning Objective:

By the end of this course, the student will be able to:

1. Understand advanced blood group systems and their clinical significance.
2. Perform and interpret compatibility testing procedures.
3. Explain blood component preparation, storage, and usage.
4. Identify and manage transfusion reactions.
5. Understand screening of transfusion-transmitted infections (TTIs).
6. Apply quality assurance and regulatory guidelines in blood banking.
7. Demonstrate knowledge of modern techniques in transfusion medicine.

Unit	Topic	Hours
I	**Advanced Blood Group Systems:** ABO and Rh systems (detailed), weak D, other blood group systems (Kell, Duffy, Kidd, MNS); genetics and clinical significance	10
II	**Compatibility Testing:** Principles and procedures of crossmatching (major, minor), antibody screening and identification, Coombs test (Direct & Indirect), troubleshooting incompatible crossmatches	10
III	**Blood Component Preparation:** Whole blood vs components, preparation of PRBC, platelets, FFP, cryoprecipitate; storage conditions, shelf life, indications for use	10
IV	**Transfusion Practices:** Indications, administration of blood/components, massive transfusion protocols, neonatal and exchange transfusion (basic concepts)	8
V	**Transfusion Reactions:** Types (acute, delayed), immunological and non-immunological reactions, signs, laboratory investigation, prevention and management	8
VI	**Transfusion Transmitted Infections (TTIs):** Screening tests for HIV, HBV, HCV, syphilis, malaria; donor selection criteria; donor screening and counseling	6
VII	**Quality Assurance & Regulations:** Quality control in blood bank, SOPs, documentation, accreditation standards (e.g., NABH/NABL), biomedical waste management, biosafety	4
VIII	**Recent Advances in Blood Banking:** Apheresis, leukoreduction, irradiation of blood products, stem cell transplantation (overview), automation in blood banks	4
Total		**60**

Suggested Reading:

1. Harmening, D. M. (2019). *Modern Blood Banking and Transfusion Practices* (7th ed.). F.A. Davis.
2. Roback, J. D., Combs, M. R., Grossman, B. J., & Hillyer, C. D. (2016). *Technical Manual* (19th ed.). AABB.
3. Klein, H. G., & Anstee, D. J. (2014). *Mollison's Blood Transfusion in Clinical Medicine* (12th ed.). Wiley-Blackwell.
4. Fung, M. K., Grossman, B. J., Hillyer, C. D., & Westhoff, C. M. (2019). *AABB Technical Manual* (20th ed.). AABB.
5. Directorate General of Health Services. (2020). *Standards for Blood Banks and Blood Transfusion Services*. Government of India.

Course Name: Histopathology and Cytology Practicals

Credit= 2 (60 hours)

Course Rationale:

This practical course trains students in basic histopathology and cytology laboratory techniques, including specimen handling, staining, microscopy, and slide interpretation. Emphasis is placed on skill acquisition, safety, and accuracy.

Learning Objective:

By the end of this course, the student will be able to:

1. Perform basic staining procedures (H&E) independently
2. Handle and process tissue samples (observation/assisted level)
3. Use microscope effectively for tissue and cell identification
4. Prepare and fix cytology smears (assisted level)
5. Follow biosafety and laboratory protocols

S. No.	Practical Exercise	Hours
1	Lab orientation and Safety	4
2	Histopathology Lab equipment handling	6
3	Tissue processing (Demonstration and Observation)	6
4	Microtome (Demonstration)	4
5	H&E staining (Hands on)	12
6	Special Stains (Demonstration – PAS/ZN)	4
7	Microscopy & Tissue Identification	12
8	Cytology Smear Preparation & Fixation	6
9	Slide Mounting, Labeling & Documentation	3
10	Quality Assurance & Error Identification	3
Total		**60**

Suggested Reading:

1. Techniques in Histopathology & Cytopathology: A Guide for Medical Laboratory Technology Students
2. Basic and Advanced Laboratory Techniques in Histopathology and Cytology by Pranab Dey
3. Handbook of Histopathology and Cytopathology for Allied Health Sciences
4. Histology Practical Manual by Balakrishna Shetty
5. Practical Applications in Histopathology, Cytopathology & Autopsy .

Course Name: Applications of Haematology Practicals

Credit= 2 (60 hours)

Course Rationale:

Hematology II practical training focuses on advanced laboratory techniques used in the diagnosis of blood disorders. It enables students to perform and interpret tests related to anemia, leukocyte and platelet disorders, and coagulation abnormalities. The course emphasizes peripheral smear examination, hematological indices, coagulation testing, and quality control, preparing students for real-world diagnostic laboratory work.

Learning Objective:

By the end of this course, the student will be able to:

1. Perform routine and special hematological tests accurately.
2. Prepare and examine peripheral blood smears and identify abnormalities.
3. Estimate hemoglobin, RBC, WBC, and platelet counts.
4. Evaluate coagulation parameters and bleeding disorders.
5. Identify hematological disorders based on laboratory findings.
6. Operate hematology instruments (basic understanding) and follow quality control procedures.
7. Maintain biosafety and proper laboratory practices.

S. No.	Practical Exercise	Hours
1	Laboratory safety, biosafety practices, PPE usage in hematology lab	3
2	Collection of blood samples (capillary and venous) and anticoagulants used	3
3	Hemoglobin estimation (Sahli's method / Cyanmethemoglobin method)	4
4	RBC count using hemocytometer	3
5	WBC count using hemocytometer	3
6	Platelet count (manual method)	3
7	Preparation of peripheral blood smear and staining (Leishman/Field stain)	5
8	Differential leukocyte count (DLC) and identification of WBCs	5
9	ESR estimation (Westergren/Wintrobe method)	3
10	Packed Cell Volume (PCV) by microhematocrit method	3
11	Red cell indices (MCV, MCH, MCHC) calculation and interpretation	3
12	Reticulocyte count and interpretation	3
13	Identification of abnormal RBC morphology (anemia types)	4
14	Platelet morphology and abnormalities	2
15	Bleeding time (BT) and clotting time (CT)	3
16	Prothrombin Time (PT) and Activated Partial Thromboplastin Time (aPTT) (demonstration)	3
17	Sickling test / osmotic fragility test (demonstration)	2
18	Bone marrow examination (demonstration/video-based)	2
19	Introduction to automated hematology analyzer (CBC parameters)	2
20	Quality control in hematology lab and error analysis	3
Total		**60**

Suggested Reading:

1. Turgeon, M. L. (2022). *Clinical Hematology: Theory and Procedures* (6th ed.). Wolters Kluwer.
2. Rodak, B. F., Fritsma, G. A., & Keohane, E. M. (2020). *Hematology: Clinical Principles and Applications* (6th ed.). Elsevier.
3. Dacie, J. V., & Lewis, S. M. (2016). *Practical Haematology* (12th ed.). Elsevier.
4. Bain, B. J. (2015). *Blood Cells: A Practical Guide* (5th ed.). Wiley-Blackwell.
5. McKenzie, S. B., & Williams, J. L. (2019). *Clinical Laboratory Hematology* (3rd ed.). Pearson.

Course Name: Clinical Applications -3 Microbiology - (Supervised Laboratory Rotation)

Credit= 2 (60 hours)

Course Rationale:

This course focuses on the clinical application of microbiological techniques for diagnosis of infectious diseases. It provides hands-on training in specimen processing, culture techniques, staining methods, identification of pathogens, and antimicrobial susceptibility testing. Emphasis is placed on real-world laboratory workflows, biosafety, and interpretation of microbiological findings, preparing students for diagnostic laboratory roles.

Learning Objective:

By the end of this course, the student will be able to:

1. Collect, transport, and process clinical specimens correctly.
2. Perform staining and culture techniques for microbial identification.
3. Identify common bacteria, fungi, and parasites using laboratory methods.
4. Perform antimicrobial susceptibility testing and interpret results.
5. Apply biosafety and infection control practices in microbiology labs.
6. Maintain proper documentation and report microbiological findings.

S. No.	Practical Exercise	Hours
1	Laboratory safety, biosafety levels, aseptic techniques, PPE usage	3
2	Collection, transport, and processing of clinical specimens (urine, sputum, blood, swabs)	4
3	Preparation of culture media (nutrient agar, blood agar, MacConkey agar)	4
4	Sterilization techniques: autoclave, hot air oven, filtration (demonstration)	3
5	Microscopy: handling and maintenance of microscope	2
6	Gram staining and interpretation	4
7	Ziehl–Neelsen staining for acid-fast bacilli	3
8	Culture techniques: streaking, inoculation, incubation methods	4
9	Identification of bacteria using colony morphology and biochemical tests (catalase, oxidase, IMViC)	6
10	Antibiotic susceptibility testing (Kirby–Bauer disk diffusion method)	5
11	Fungal examination: KOH mount, culture techniques	4
12	Parasitology: stool examination (wet mount, concentration methods)	4
13	Blood culture methods (demonstration)	2
14	Rapid diagnostic tests (malaria, dengue, typhoid – demo/interpretation)	3
15	Quality control in microbiology lab and contamination control	3
16	Biomedical waste management in microbiology laboratory	3
17	Record keeping, result reporting, and case-based interpretation	3
Total		**60**

Suggested Reading:

1. Ananthanarayan, R., & Paniker, C. K. J. (2017). *Textbook of Microbiology* (10th ed.). Universities Press.
2. Cheesbrough, M. (2010). *District Laboratory Practice in Tropical Countries* (2nd ed.). Cambridge University Press.
3. Collee, J. G., Fraser, A. G., Marmion, B. P., & Simmons, A. (2014). *Mackie and McCartney Practical Medical Microbiology* (14th ed.). Churchill Livingstone.
4. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2021). *Medical Microbiology* (9th ed.). Elsevier.
5. Parija, S. C. (2016). *Textbook of Medical Parasitology* (5th ed.). Elsevier.

SEMESTER 4

Clinical Training Rotations (Competency-Based Clinical Posting – NCAHP Aligned)

Course Name	Lecture	Tutorial	Practical	Credits	Contact Hours
Clinical Lab Rotation 1 – Clinical Chemistry	0	0	5	5	225 hours
Clinical Lab Rotation 2 – Microbiology	0	0	5	5	225 hours
Clinical Lab Rotation 3 – Hematology & Blood Bank	0	0	5	5	225 hours
Clinical Lab Rotation 4 – Histopathology & Cytology	0	0	5	5	225 hours
Total	**0**	**0**	**20**	**20**	**900 hours**

Key Features

✓ Total Clinical Training: 900 hours

✓ Credits Allocated: 20 (Fully practical-based)

✓ Equal exposure across all 4 core lab domains

✓ Designed for competency-based progression (Observe → Assist → Perform)

Suggested Implementation

- Duration per rotation: ~8–10 weeks
- Hours per week: 25–30 hours
- Maintain:
  - Logbook entries
  - Supervisor signatures
  - Skill competency tracking

Competency Coverage Across Rotations

Rotation	Core Skills Developed
Clinical Chemistry	Biochemical analysis, analyzer handling
Microbiology	Aseptic technique, staining, culture
Hematology & Blood Bank	CBC, smear, grouping, cross-match
Histopathology & Cytology	H&E staining, microscopy, smear prep

A. RECOMMENDED DETAILED CLINICAL ROTATION SCHEDULE (DAY-WISE)

Total Duration: 900 Hours

- 4 Rotations × 225 hours each
- 9 weeks per rotation
- 5 days/week
- 5 hours/day

ROTATION 1: CLINICAL CHEMISTRY (9 WEEKS)

Week 1–2: Orientation & Pre-Analytical Phase

- Day 1: Lab orientation, safety, SOPs
- Day 2: Sample types & labeling
- Day 3: Sample collection overview
- Day 4: Sample transport & storage
- Day 5: Centrifugation & serum separation

Week 3–5: Analytical Techniques

- Day 1–2: Colorimeter use
- Day 3–4: Semi-auto analyzer operation
- Day 5: Calibration & QC

(repeat with different tests: glucose, urea, creatinine, etc.)

Week 6–7: Routine Biochemistry Tests

- Daily practice:
  - Blood glucose
  - Urea
  - Creatinine
  - LFT parameters

Week 8: Quality Assurance

- QC charts
- Error detection
- Maintenance logs

Week 9: Reporting & Assessment

- Result validation
- Report writing
- Mock OSCE

ROTATION 2: MICROBIOLOGY (9 WEEKS)

Week 1–2: Lab Safety & Aseptic Techniques

- PPE, biosafety
- Sterilization methods
- Media preparation

Week 3–4: Microscopy & Staining

- Gram staining
- Ziehl-Neelsen staining
- Wet mount

Week 5–7: Culture Techniques

- Inoculation methods
- Incubation
- Colony identification

Week 8: Antibiotic Sensitivity

- Kirby-Bauer method
- Interpretation

Week 9: Reporting & QA

- Culture reports
- Error analysis

ROTATION 3: HEMATOLOGY & BLOOD BANK (9 WEEKS)

Week 1–2: Sample Handling

- Blood collection (demo/assist)
- Anticoagulants
- Sample processing

Week 3–5: Hematology Tests

- Hb estimation
- TLC
- DLC
- ESR

Week 6–7: Blood Banking

- ABO grouping
- Rh typing
- Cross-matching

Week 8: Quality Control

- Instrument calibration
- Error detection

Week 9: Reporting & Assessment

- Result interpretation
- OSCE practice

ROTATION 4: HISTOPATHOLOGY & CYTOLOGY (9 WEEKS)

Week 1–2: Lab Orientation & Tissue Handling

- Fixation
- Specimen labeling
- Safety

Week 3–4: Tissue Processing

- Dehydration
- Clearing
- Embedding

Week 5–6: Staining Techniques

- H&E staining (daily practice)
- Slide mounting

Week 7–8: Microscopy

- Tissue identification
- Slide interpretation

Week 9: Cytology & QA

- Smear preparation
- Error identification
- Final assessment

B. CLINICAL LOGBOOK (ROTATION-SPECIFIC FORMAT)

1. Student Information Page

- Name:
- Enrollment No:
- Institution:
- Duration:
- Batch:

2. Daily Attendance Record

Date	Department	Hours	Signature

3. Skill Competency Log (Core Section)

Skill	Date	Attempt	Level (O/A/P*)	Faculty Sign	Remarks

Legend:

- O = Observed
- A = Assisted
- P = Performed independently

4. Recommended Department-wise Skill Checklist

Clinical Chemistry

- Glucose estimation
- Urea estimation
- Analyzer operation
- QC interpretation

Microbiology

- Gram staining
- Culture inoculation
- Antibiotic sensitivity

Hematology & Blood Bank

- Hb estimation
- TLC/DLC
- Blood grouping
- Cross-matching

Histopathology & Cytology

- H&E staining
- Slide mounting
- Tissue identification
- Cytology smear

5. Minimum Procedural Requirements

Skill	Minimum Number
Hb estimation	20
TLC	15
Gram stain	20
Blood grouping	15
H&E staining	10

6. Supervisor Evaluation Sheet

Domain	Rating (1–4)	Remarks
Knowledge		
Technical Skill		
Safety		
Communication		
Professionalism		

7. Final Certification

- Certified that the student has completed 900 hours of clinical training
- Faculty Name & Signature
- Head of Department Signature