



SEMESTER – II

PAPER CODE	SUBJECT NAME	THEORY HOURS	PRACTICAL HOURS	THEORY MARKS	PRACTICAL MARKS
DMLT201	MEDICAL LAB TECHNOLOGY & INSTRUMENTATION	45 Min	1 Hrs.	50	50
DMLT202	CLINICAL BIOCHEMISTRY	45 Min	1 Hrs.	50	50
DMLT203	BLOOD SAMPLE COLLECTION	45 Min	1 Hrs.	50	50
DMLT204	BLOOD BANKING	45 Min	1 Hrs.	50	50

MEDICAL LAB TECHNOLOGY & INSTRUMENTATION

This subject introduces laboratory instruments, their working principles, handling, and maintenance, which are critical for accurate diagnostic testing.

Theory syllabus

1. Introduction to Medical Laboratory Instruments

- Importance of instrumentation in laboratory diagnosis
- Classification of laboratory instruments
- Basic principles of laboratory devices

2. Weighing and Measuring Devices

- Types of balances: Analytical and digital balances
- Proper use and care of balances
- Measuring instruments: Measuring cylinders, pipettes, burettes, micropipettes

3. Colorimetry and Spectrophotometry

- Principle of colorimetry (Beer-Lambert law)
- Parts and working of a colorimeter
- Principle and components of spectrophotometer
- Applications in clinical biochemistry
- Maintenance and calibration

4. pH Meter

- Principle and working of pH meter
- Calibration and maintenance
- Measurement of pH in biological samples



5. Centrifuge

- Types: Bench-top, high-speed, refrigerated
- Principle of centrifugation
- Applications: Separation of serum, plasma, urine sediment
- Balancing, care, and safety precautions

6. Incubator and Hot Air Oven

- Principle and uses in microbiology and sample incubation
- Temperature regulation and maintenance
- Cleaning and safety precautions

7. Water Bath and Heating Devices

- Use in serology, biochemistry, microbiology
- Types: Simple water bath, serological water bath
- Thermostatic control, precautions

8. Autoclave and Sterilizers

- Principle of steam sterilization
- Operation of autoclave: Temperature, pressure, time
- Validation and safety precautions
- Hot air oven: Uses in dry sterilization

9. Microscopes

- Types: Light microscope, compound microscope, fluorescence microscope (introductory)
- Parts and functions
- Handling, cleaning, and maintenance

10. Electrolyte Analyzers and Semi-Auto Analyzers

- Principle and function
- Sample handling and result interpretation
- Common troubleshooting

11. Blood Cell Counters (Hematology Analyzers)

- Principle of automated cell counting
- Types: 3-part and 5-part analyzers
- Sample loading, maintenance, and result interpretation

12. Quality Control in Instrumentation

- Importance of calibration and QC in lab instruments
- Preventive maintenance
- Logbook maintenance and documentation



- Equipment validation

Practical Syllabus

➤ **Handling and Operation of Instruments**

- Weighing using analytical and digital balances
- Measurement using pipettes and burettes
- Use of micropipettes with calibration

➤ **Colorimeter and Spectrophotometer**

- Operating a colorimeter for blood glucose, protein estimation
- Use of spectrophotometer (demo/practice if available)

➤ **pH Meter**

- Calibration using buffer solutions
- Measurement of sample pH

➤ **Centrifuge**

- Balancing tubes
- Operation for serum/plasma separation

➤ **Autoclave and Hot Air Oven**

- Operation steps, safety checks
- Use of indicator tape and validation

➤ **Incubator and Water Bath**

- Setting and checking temperature
- Applications in culture incubation

➤ **Microscopy**

- Parts identification
- Cleaning and focusing slides under different magnifications

➤ **Semi-Auto Analyzer / Cell Counter (if available)**

- Sample preparation
- Loading and interpretation of results

➤ **Maintenance Logs**

- Daily/weekly maintenance checklist for lab instruments
- Sample instrument logbook entry

CLINICAL BIOCHEMISTRY



Theory syllabus

1. Introduction to Clinical Biochemistry

- Definition and scope
- Role of biochemistry in disease diagnosis
- Safety rules in a biochemistry laboratory
- Sample collection, preservation, and processing
- Pre-analytical, analytical, post-analytical phases

2. Carbohydrate Metabolism and Analysis

- Digestion and absorption of carbohydrates
- Blood glucose regulation (insulin, glucagon)
- Disorders: Diabetes mellitus, hypoglycemia
- Estimation of:
 - Fasting and postprandial blood glucose
 - Glycosylated hemoglobin (HbA1c)
 - Glucose tolerance test (GTT)

3. Protein and Amino Acid Metabolism

- Structure, types, and functions of proteins
- Protein digestion and absorption
- Disorders: Proteinuria, hypo/hyperproteinemia
- Estimation of:
 - Total protein
 - Albumin and A/G ratio
 - Urea and uric acid
 - Creatinine

4. Lipid Metabolism and Analysis

- Digestion and absorption of fats
- Lipoproteins: LDL, HDL, VLDL
- Lipid profile:
 - Total cholesterol
 - Triglycerides
 - HDL/LDL estimation
- Atherosclerosis and hyperlipidemia

5. Liver Function Tests (LFT)

- Bilirubin metabolism
- Estimation of:
 - Total and direct bilirubin
 - ALT (SGPT), AST (SGOT)
 - Alkaline phosphatase
 - Serum proteins (albumin, globulin)
- Clinical interpretation in hepatitis, cirrhosis



6. Kidney Function Tests (KFT)

- Role of kidneys in waste excretion
- Estimation of:
 - Blood urea
 - Serum creatinine
 - Uric acid
 - Electrolytes (Na^+ , K^+ , Cl^- – introductory)
- Clearance tests (introductory)

7. Acid-Base Balance and Electrolytes

- pH, buffer systems
- Acid-base disorders: Acidosis, alkalosis (introductory)
- Sodium, potassium, chloride – roles and estimation (basic)

8. Enzymes in Clinical Diagnosis

- Definition and classification
- Diagnostic enzymes:
 - AST, ALT
 - Amylase, lipase
 - ALP, ACP, LDH, CK
- Clinical interpretation in myocardial infarction, pancreatitis, liver disease

9. Endocrine Function Tests (Introductory)

- Hormones: Types and functions
- Thyroid function tests: T3, T4, TSH
- Blood glucose as part of endocrine test (insulin function)

10. Automation in Clinical Biochemistry

- Semi-auto and fully automated analyzers
- Use of photometry and spectrophotometry
- Quality control: Internal and external
- Calibration and maintenance of instruments

Practical Syllabus

➤ Sample Collection and Processing

- Blood and urine sample handling
- Serum and plasma separation
- Use of anticoagulants

➤ Estimation Techniques

- Blood glucose (Glucose oxidase/peroxidase method)
- Urea (diacetyl monoxime or enzymatic method)
- Creatinine (Jaffe's method)



- Total protein (Biuret method)
- Albumin (BCG method)
- Cholesterol (CHOD-PAP method)
- Triglycerides
- Liver function tests (ALT, AST, bilirubin)

➤ **Instrumentation**

- Use of colorimeter and semi-auto analyzer
- Use of centrifuge, pipette, and pH meter
- Calibration of instruments

➤ **Quality Control**

- Preparation of standard curves
- Use of controls and reagents
- Interpretation and recording of results

➤ **Urine Biochemistry (Qualitative)**

- Protein (heat and acetic acid, sulfosalicylic acid)
- Glucose (Benedict's test)
- Ketone bodies (Rothera's test)
- Bile salts and pigments

BLOOD SAMPLE COLLECTION

It includes theoretical knowledge and practical procedures essential for safe and effective phlebotomy.

Theory syllabus

1. Introduction to Blood Collection

- Purpose and importance of blood collection
- Types of blood samples:
 - **Venous blood** (most common)
 - **Capillary blood** (finger/heel prick)
 - **Arterial blood** (for blood gas analysis – advanced)

2. Methods of Blood Collection

- **Venipuncture** (common for laboratory tests)
- **Capillary puncture** (in infants, glucose testing, etc.)
- Arterial puncture (only in special settings)

3. Equipment for Blood Collection

- Tourniquet



- Sterile needles and syringes
- Vacutainer tubes (EDTA, Citrate, Heparin, Fluoride, Plain, Gel tubes)
- Butterfly needle (for difficult veins)
- Alcohol swab, sterile gauze, cotton, and bandages
- Needle disposal container (sharp bin)

4. Anticoagulants and Their Use

Anticoagulant	Tube Color	Use
EDTA	Lavender	CBC, hematology tests
Sodium Citrate	Light Blue	Coagulation tests (PT, APTT)
Fluoride Oxalate	Grey	Blood glucose
Heparin	Green	Biochemistry
No Additive	Red	Serum-based tests

5. Site Selection for Venipuncture

- Preferred vein: **Median cubital vein**
- Alternatives: Cephalic vein, basilic vein
- Avoid: Infected/injured sites, IV sites, scar tissue

6. Procedure for Venipuncture

1. Verify patient identity and fasting status
2. Assemble all required equipment
3. Apply tourniquet 3–4 inches above puncture site
4. Clean site with 70% alcohol in circular motion
5. Allow to dry, insert needle at 15–30° angle
6. Collect required amount of blood in appropriate tubes
7. Release tourniquet before removing needle
8. Apply gauze and ask patient to press
9. Label all tubes properly before leaving bedside
10. Dispose of sharps and gloves safely

7. Capillary Blood Collection

- Site: Finger (adults), heel (infants)
- Use of lancets, micropipettes, or capillary tubes
- Used for: Glucose, malaria, hemoglobin tests

8. Precautions During Blood Collection

- Never draw blood above an IV line



- Avoid excessive probing or blind puncture
- Never reuse needles or syringes
- Maintain aseptic technique
- Always label samples immediately

9. Complications and Errors

- Hematoma formation
- Fainting/syncope
- Hemolysis of sample
- Clotted sample due to delay in mixing
- Wrong tube or improper filling

10. Transport and Storage of Blood Samples

- Serum/plasma separation within 1–2 hours
- Maintain cold chain if required
- Avoid exposure to direct sunlight or heat
- Label with time and date of collection

Practical Syllabus

➤ Hands-on Training

- Demonstration of venipuncture (on manikins or simulation arms)
- Practice of capillary blood collection (finger prick)
- Sample collection in vacutainers and syringes

➤ Tube Identification and Use

- Color-coded tube identification
- Correct order of draw (to avoid cross-contamination of additives)

➤ Labeling and Documentation

- Writing patient name, date, time, and test name on sample
- Use of barcode systems (where applicable)

➤ Safety and Hygiene Practices

- Donning and doffing gloves
- Use of hand sanitizer and handwashing
- Disposal of used needles in sharp containers

BLOOD BANKING

This subject deals with the collection, testing, storage, and transfusion of blood and its components, ensuring safe blood transfusion practices.



Theory syllabus

1. Introduction to Blood Banking

- Definition and history of blood banking
- Structure and functions of a blood bank
- Role of blood bank in healthcare
- Blood bank organization and licensing norms (NACO, FDA)

2. Basic Hematology for Blood Banking

- Composition and functions of blood
- Structure and functions of RBCs, WBCs, platelets
- Plasma and serum: Difference and clinical use

3. Blood Groups and Typing

- ABO blood group system
- Rh blood group system
- Other blood group systems (Kell, Duffy – overview)
- Forward and reverse grouping
- Weak D (Du) testing
- Bombay blood group (introductory)

4. Collection of Blood from Donors

- Donor selection criteria (age, weight, hemoglobin, etc.)
- Blood donation process
- Blood collection bags and anticoagulants (CPDA, EDTA, ACD)
- Volume of collection and labeling
- Donor reactions and management

5. Compatibility Testing (Crossmatching)

- Major and minor crossmatch
- Direct and indirect antiglobulin tests (Coombs test)
- Causes of incompatibility
- Interpretation and troubleshooting

6. Component Separation and Storage

- Types of blood components:
 - Packed RBCs
 - Platelet concentrate
 - Fresh Frozen Plasma (FFP)
 - Cryoprecipitate
- Centrifugation techniques
- Storage conditions and shelf-life for each component

7. Transfusion Transmitted Infections (TTI)



- Mandatory screening tests:
 - HIV 1 & 2
 - Hepatitis B & C
 - Syphilis
 - Malaria (where applicable)
- ELISA, rapid tests, chemiluminescence (introductory)
- Interpretation and reporting of TTI results

8. Storage and Preservation of Blood

- Blood bank refrigerator (2–6°C)
- Deep freezers for FFP
- Platelet agitator/incubator
- Temperature monitoring and recording
- Cold chain maintenance

9. Adverse Reactions to Transfusion

- Hemolytic transfusion reactions
- Allergic and febrile reactions
- Anaphylactic reactions
- Post-transfusion infection
- Management and reporting of reactions

10. Quality Control and Documentation

- Quality assurance in blood bank operations
- Calibration and maintenance of blood bank equipment
- Standard operating procedures (SOPs)
- Record keeping: Donor records, blood issue register, stock register
- NABH/NACO/WHO guidelines (introductory)

Practical Syllabus

➤ Blood Grouping

- Forward and reverse ABO grouping
- Rh (D) typing and weak D testing

➤ Crossmatching

- Major and minor crossmatch procedures
- Coombs test (Direct & Indirect)

➤ Donor Room Practices

- Demonstration of donor screening
- Preparation of blood bag and labeling
- Sample collection for testing

➤ TTI Screening (Demonstration/Hands-on)



- Rapid test and ELISA (if available)
- Sample processing and interpretation
- **Component Preparation (Demo or Practice)**
 - Use of centrifuge for blood separation
 - Labeling and storage of components
- **Equipment Use**
 - Blood bank refrigerator, platelet incubator
 - Use and maintenance of temperature logbooks
- **Record Keeping**
 - Donor and recipient records
 - Blood issue and transfusion reaction forms

