Second Semester Syllabus
Masters in Medical Laboratory Science and Technology (MLST)

Semester II

II Semester = 26 weeks × 6 days × 5 hours = 780 hours [18 lecture hour = 1 credit (36 hours = 1 credit in practical)]

Course	Course Code	Credit
Immunology & Bacterial Serology	ML201	4
Haematology	ML202	4
Clinical Biochemistry	ML203	4
Histopathology	ML204	4
Immunology and Bacterial Serology (Practical)	ML205	2
Haematology (Practical)	ML206	2
Clinical Biochemistry (Practical)	ML207	2
Histopathology (Practical)	ML208	2
Values & Indian Heritage	ML209	2
Total		26

8 THEORETICAL COURSES (6 courses X 2 credits and 2 courses X 1 credit) & 5 PRACTICAL COURSES (4 courses 1 credit each and 1 course of 2 credits)
Total **14 credit + 6 credit**, 252 + 216 = 468 hours

ML201 and ML205 Immunology & Bacterial serology Credit: 4 + 2 (Theory + Practical) MLST

Unit 1: Introduction to immunology-serology
Historical back ground

Unit 2: Immunity

Definition of immunity and elaboration.

Unit 3: The lymphoid system

Lymphoid tissue; The lymphocytes

Unit 4: The antigen, antibodies and the complement system

Antigen; Antibodies; Immunoglobulin; Complement system

Unit 5: The cellular immunity

Cell mediated immune response; delayed type of hypersensitivity; Autoimmune disease

Unit 6: Antigen- antibody interaction

Principle of antigen antibody interaction; In vitro antigen antibody reaction; Factor affecting antigen antibody reaction

Unit 7: Serological techniques

Materials necessary for basic serology tests; Collection, preparation and preservation of specimen for serologic test; Shipment of serologic specimen; Complement inactivation; Serial dilution; determinations of end point and titre

Unit 8: Syphilis serology

Treponematoses; Syphilis; Tests for syphilis

Unit 9: Agglutination test for febrile diseases

Typhoid and paratyphoid fever; Rickettsial diseases; *Brucella abortus*

Unit 10: Human chorionic gonadotropin hormone

HCG and pregnancy; Pregnancy test; Specimen collection; Factors affecting pregnancy tests

Unit 11: Human immunodeficiency virus

Disease characteristics and clinical manifestation; Laboratory diagnosis

Unit 12: Hepatitis virus

Unit 13: C-reactive protein

Unit 14: Infectious mononucleosis

Epistien-Barr Virus; hetrophil antibodies; Serological tests

Unit 15: Streptolysin o

Unit 16: Rheumatoid factor

Practical

Each Unit in ML201 has a corresponding practical session (~ML 205) which may either be a demonstration or hand-on as per the feasibility of the host institutions.

Recommended books:

1. Baker F.J. Introducion to Medical Laboratory Technology;6thed, 1995.Butter worth.
2. Cheesbrough Monica. Medical Laboratory Manual for Tropical Countries; vol ll 2000.Cambridge Butter worth.Heinemann.Ltd.
3. P.Stities Daniel. Basic and Clinical Immunology; 8thed, 1994,USA 4.Fischbach Frances, Manual of Laboratory and Diagnostic tests; 4ed 1992,Lippincott.

5. Turgeon L.M, Immunology and Serology in Laboratory Medicine,2nded, 1996,Mosby.
6. Sood Ramnik. Medical laboratory Technology methods and interpretation.4thed, New Delhi-India, Jaypee Brothers.

ML202 and ML 206 Haematology Credit: 4 + 2 (Theory + Practical) MLST

Unit 1: Introduction to haematology

Introduction to clinical hematology and Laboratory hematology; Basic morphology and basic concepts of hematopoiesis; Bone marrow structure and examination; Red blood cells: Structure and function; Laboratory approach to diagnosis of anemia; Development of Immune system; Overview of normal hemostatic mechanism; Laboratory approach to diagnosis of bleeding disorders; Clinical evaluation and management of inherited bleeding disorders; Laboratory approach to diagnosis of leukemias; Laboratory methods in hematology: a. Principles of automated cell counter and interpretation of results. b. Hemoglobin electrophoresis. c. HPLC use in hematology. d. Special stains and cytochemistry. e. Flow cytometry and its applications. f. Diagnostic procedures for analyzing DNA; Principles of Nuclear Medicine: and applications in hematology & oncology

Unit 2: Disorders of Erythrocytes

Iron metabolism and iron deficiency anemia; Megaloblastic anemia; Red cell membrane defect: hereditary spherocytosis; Red cell enzymopathies; Thalassemia: (a) Clinical aspects and community screening (b) molecular genetics; Sickle cell anemia; Abnormal hemoglobins; Immune hemolytic anemias.

Unit 3: Disorders of white cells

Cell Cycle and Carcinogenesis; Principles of chemotherapy; Quantitative defect of neutrophils; Reactive lymphocytosis; Introduction to acute leukemias;Immunophenotype of acute leukemias; Cytogenetics of acute leukemias; Acute lymphoblastic leukemia in children; Acute lymphoblastic leukemia in adults; Acute myeloid leukemia; Acute promyelocytic leukemia; Minimal residual disease in acute leukemia; MDR genes in Leukemia; Chronic myeloid leukemia; Chronic lymphocytic leukemia; Hairy cell leukemia; T cell lymphoproliferative disorders; Bone marrow transplantation; Disorders of spleen

Unit 4: Disorders of Hemostasis and Thrombosis

Laboratory diagnosis of platelet function defects; Overview of megakaryopoiesis; Quantitative platelet disorders; Qualitative platelet disorders; ITP; TTP/HUS; Hemophilia a. genetics; prenatal diagnosis. b. Laboratory diagnosis. c. Special management issues; Von Willebrand's disease a. Laboratory diagnosis. b. Management; Dysfibrinogemias; Other rare coagulation disorders; Fibrinolysis and defects of fibrinolytic pathway; Disseminated intravascular coagulation; Lupus anticoagulant a. Lab diagnosis. b. Clinical presentation and

management; Acquired disorders of coagulation; Hemostasis in the Newborn; Bleeding disorders in the Newborn.

Unit 5: Disorders of hemostasis, thrombosis and erythrocytes Part II.

Pathophysiology of thrombosis; Inherited thrombotic disorders; Laboratory testing of prothrombotic state; Thrombosis in adults: Management issues; Pediatric issues in thrombosis; Thrombosis and pregnancy; Bone marrow failure syndrome a. aplastic anemia. b. Paroxysmal nocturnal hemoglobinuria; Hematological manifestation syndrome disease; Red cell disorders in pregnancy; Red cell disorders in the newborn; Polycythemia; Infections and hematological problems.

Unit 6: Disorders of white cells Part II.

Miscellaneous topics a. Transfusion medicine. b. Immuno hematology. c. Consultative hematology. d. Quality assurance program; Myelodysplastic syndrome; Idiopathic myelofibrosis/essential thrombocythemia; Non-Hodgkin's lymphoma; Hodgkin disease; Plasma cell disorders; Histiocytosis; Infections and blood transfusions; Complications of blood transfusion; Hematological manifestation of HIV; Consultative hematology a. Obstetrics and Gynecology. b. Surgery; Blood and component therapy; Blood safety program.

Practical:

Each Unit in ML202 has a corresponding practical session (~ML 206) which may either be a demonstration or hand-on as per the feasibility of the host institutions.

Recommended books:

1. Desk Reference for Haematology – N. K. Shinton (CRC Press)
2. Clinical Haematology Atlas – Bernadette F. Rodak (Elsevier)
3. Haematology and Oncology Subspeciality Consult – Amanda F. Cashen MD and Brian A. Van Tine MD (Wolters Kluwer)
4. Williams Manual of Haematology – marshall Lichtman, Josef Prchal, et al. (Mc Graw Hill)
5. The Bethesda Handbook of Clinical Haematology – Griffin P. Rodgers and Neal S. Young (Wolters Kluwer)

ML203 and ML207 Clinical Biochemistry Credit: 4 + 2 (Theory + Practical) MLST

Unit 1: Enzymes

Principles and classifications of Enzymes; Mechanism action of Enzymes; Enzyme Inhibition; Regulation of Enzyme activity; Enzymes in clinical diagnosis

Unit 2: Carbohydrate Metabolism

Chemistry of Carbohydrates; Functions of Carbohydrates; Digestion and absorption of Carbohydrates; Glycolysis; Glycogen Metabolism; Glycogen storage diseases; Pentose phosphate pathway; The Cori – cycle; Gluconeogenesis

Unit 3: Integrative Metabolism Bioenergetics

Introduction; Structural basis of high energy phosphate; Formation and utilization of ATP; Catabolism of fuel molecules; Concept of Free energy; Oxidation-reduction reactions; Aerobic energy generation; Kreb's cycle; Function and regulation of kreb's cycle; Electron transport system and oxidative Phosphorylation; Respiratory control; Uncouplers; Respiratory poisons

Unit 4: Lipid Metabolism

Classification of Lipids; Types of Lipids; Digestion and absorption of Lipids; Metabolism of Fatty acids and Triacyl Glycerols; β-Oxidation of Fatty acids; Metabolism of Ketone bodies; Biosynthesis of Fatty acids and triacyl glycerols; Cholesterol Metabolism; Atherosclerosis; Hypercholesterolemic drugs; Lipid storage diseases; Fatty Liver; Lipoproteins; Chemical compositions of Membranes

Unit 5: Amino acids and Proteins

Classification of amino acids; Properties of amino acids; Peptides; Glutathione synthesis; Proteins; Classifications of proteins; Levels of organization of proteins; Denaturation of proteins; Hemoglobin and Myoglobin; Sickle cell Hemoglobin; Sickle cell disease, Sickle cell trait; Digestion and absorption of proteins; Amino acid catabolism; Nitrogen balance, excretion and the urea cycle; Defects in the urea cycle; The Glucose - Alanine cycle; Inborn errors of amino acid metabolism; Amino acid derived nitrogenous compounds; Clinical problems.

Unit 6: Vitamins and Coenzymes

Water soluble vitamins Chemistry, sources, function and deficiency of:
Thamine; Riboflavin; Niacin; Pyridoxine; Biotin; Cobalamin; Folic acid; Panthothenic acid; Ascorbic acid; Fat soluble vitamins; Chemistry, Sources, function, deficiency and Hypervitaminosis of: Vitamin A, Vitamin D, Vitamin E, Vitamin K

Unit 7: Mineral Metabolism

Mineral; Sodium and Potassium; Calcium and Phosphate; Trace elements; Iron; Copper; Magnesium; Flourine; Iodine; Zinc; Selenium

Unit 8: Hormones

Definition and classification; Biosynthesis, storage, transport; Mechanism of action of steroid hormones; Mechanism of action of protein hormones; Receptors and diseases; Second messengers; Insulin synthesis, secretion and metabolic role; Diabetes mellitus: Symptoms and

complications of DM; Glucagon: Clinical aspects; Thyroxin: Synthesis and Metabolism; Hypo and Hyper Thyroidism; Goiter; Catecholamines; Pheochromocytoma; Case Histories

Unit 9: Molecular Genetics

Structure of Nucleic acids; Types of Nucleic acids; Replication of DNA; DNA Damage and repair mechanism; RNA synthesis; Post transcriptional Modifications; Translation/Protein synthesis; Regulation of protein synthesis; The Genetic code; Post translational processes;

Practical:

Each Unit in ML203 has a corresponding practical session (~ML 207) which may either be a demonstration or hand-on as per the feasibility of the host institutions.

Recommended Books:

1. Robert K., Murray R. K., Granner D. K., Mayes P. A., Rodwell, V. W. 1993. Harpers Biochemistry. 23rd ed. Prentice-Hall International Inc.
2. Lehninger A. L. 1975. Biochemistry. 2nd ed. Worth publishers Inc.
3. Colby D. S. 1985. Biochemistry: A synopsis. Middle east edition
4. Schlegel H. G. 1986. General microbiology. 6th ed. Cambridge University Press.
5. Champe P. C. Harvey R. A. 1994. Lippincott's Illustrated Review: Biochemistry. 2nd ed. J. B. Lippincott company.
6. Apps D. K., Cohn B. B. and Steel C. M. 1992. Biochemistry. A concise text for medical students. 5th ed. ELBS with Baillie're Tindall.
7. Baynes.Dominiczak, Medical Biochemistry: 1999.
8. Thomas M.Devlin, Textbook of Biochemistry, fourth edition: 1997.
9. 10. Wood.Wilson: Biochemistry a problem based approach, third edition: 1998. 11. Nath R.K, A textbook of Medical Biochemistry: 1996.
   12. David L.Nelson, Michael M.Cox, Priciple of Biochemistry, third edition: 2000. 13. Guyton and Hall, Textbook of Medical Physiology, ninth edition: 1996.

ML204 and ML208 Histopathology Credit: 4 + 2 (Theory + Practical) MLST

Unit 1: Introduction

An Introduction Definitions; Histology; Cytology; Cytopathology; Histopathology; Anatomic pathology

Unit 2: Animal Cell

An Overview of an Animal Cell Diagram of Eukaryotic Cells Functions of the Cytoplasmic Organelles; Golgi apparatus; Mitochondria; Smooth endoplasmic reticulum; Rough endoplasmic reticulum; Lysosome; Nucleus; Nucleolus; Cell membrane; Nuclear membrane; Cytoplasmic Inclusions; Glycogen; Lipid droplets; Pigments Cell Division; Mitosis; Meiosis

Unit 3: Tissues

Tissues Epithelial Tissue Location, and Functions; Simple squamous epithelium; Stratified keratinizing squamous epithelium; Stratified nonkeratinizing squamous epithelium; Simple cuboidal epithelium; Simple columnar epithelium Semesters 5 and 6 124 Competency-Based Curriculum: Pre-Service Training for Medical Laboratory Technicians; Simple columnar and ciliated epithelium; Transitional columnar epithelium; Glandular tissues, endocrine and exocrine tissue Connective Tissue Location, Structure, and Function; Connective tissue cells (cells, fibers, and matrix); Loose connective tissue (areola tissue); Dense collagenous connective tissue (regular and irregular); Adipose connective tissue; Cartilage (hyaline, fibrous, and elastic); Bone Muscular Tissue Location; Mode of Contraction, and Structure; Skeletal muscle; Smooth muscle; Cardiac muscle Nervous Tissue Location and Structure; Peripheral nervous system; Central nervous system

Unit 4 Histopathology Laboratory

Reception of surgical specimen; Identification; Grossing; Processing; Embedding; Microtomy; Staining; Microscopic examination

Unit 5: Pathological Conditions

Introduction to Pathological Conditions; Inflammation; Necrosis; Neoplasia

Unit 6: Histological Methods

Fresh Unfixed Tissues; Frozen sections; Examination of Fixed Tissue; Fixation or preservation of tissue; Aims of fixation; Effects of fixation Decalcification of Tissue; Purpose of decalcification; Methods of decalcifying tissues; Acids: weak and strong; Ethylenediaminetetraacetic acid; Electrolytic; Common decalcifying solutions; Different methods of determining endpoint of decalcification: X-ray method, Chemical method, Crude method Automated and Manual Tissue Processing for Paraffin Blocks; Dehydration; Clearing; Wax impregnation; Dehydrates; Clearing agents; Vacuum impregnation; Different embedding mold Embedding Media and Their Uses; Paraffin wax; Ester wax; Cellulose nitrate (celloidin and low-viscosity nitrocellulose); Water-soluble waxes; Gelatin; Bum Microtomy; Different types of microtomes used in histology: Rotary, Base sledge, Sliding, Cryostat, Jung K. M., Bench freezing microtome; Different types of microtome knives: Wedge shaped (profile C), Plano concave (profile A), Biconcave (profile BL), Tool edge (profile D) Maintenance of Steel Knives; Methods of knife sharpening: Automated knife sharpening, Manual knife sharpening (hones and strops); Section Cutting; Use of adhesives; Use of floating out baths; Use of slide dryers (hot plates and ovens) Faults in Section Cutting; Scores; Chatters; Alternate thick; Thin sections; Ribbons curve

Unit 7: Staining

Staining Examples; Natural dyes; Synthetic dyes Basic Structure of Synthetic Dyes; Dye Classification: Basic dyes, Acidic dyes, Neutral dyes, Amphoteric dyes, Metachromatic dyes; Leuco bases Differentiation: Progressive staining, Regressive staining; Mordant; Accentuators; Trapping agent; Ripening of hematoxylins; Physical dye staining (permeability, density of tissues, and adsorption)

Unit 8: Pigments

Describe the Various Pigments and Their Methods of Demonstration; Artificial pigments; Endogenous pigments; Exogenous pigments

Unit 9: Microbe Identification

Identification of Microorganisms: Bacteria, Fungi, Protozoa, Amoeba, Virus

Practicals:

Each Unit in ML204 has a corresponding practical session (~ML 208) which may either be a demonstration or hand-on as per the feasibility of the host institutions.

Recommended Books:

1. Bancroft JD, Gamble M. 2007. Theory and Practice of Histological Techniques. 6th ed. London: Churchill Livingstone.
2. Bergman RA, Heidger PM, Afifi AK. Histology. Philadelphia: Saunders. Carleton HM, Drury RAB, Wallington EA.
3. Carleton's Histological Technique. Oxford, UK: Oxford University Press.
4. Kumar V, Abbas AK, Aster JC. 2015. Robbins and Cotran Pathologic Basis of Disease. Philadelphia: Elsevier/Saunders.
5. Wheather PR, Burkitt HG, Daniels VG, Deakin PJ. 1987. Functional Histology: A Text and Colour Atlas. Edinburgh: Churchill Livingstone.

CL209 Values and Indian Heritage Credit: 2 (Theory) MLST