

**OPJS UNIVERSITY, CHURU(RAJASTHAN)**



**SYLLABUS**

**For**

**M.Sc. in**

**Medical Laboratory Technology**

**M.Sc.-(MLT)**

**(Academic Program)**

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**School of Para-Medical Science**

**OPJS UNIVERSITY, CHURU(RAJASTHAN)**

**2016-17**

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**Detailed Syllabus**  
**MSC IN MEDICAL LABORATORY TECHNOLOGY**

**First Year**

Course Code	Course Title	Distribution of Marks	
		Theory/ Practical	Continuous Assessment
MSLT-101	Fundamentals of Medical Laboratory Technology	70	30
MSLT-102	Human Anatomy & Physiology	70	30
MSLT-103	Molecular Biology & Clinical Biochemistry	70	30
MSLT-104	Clinical Pathology	70	30
MSLT-105(P)	Molecular Biology & Biochemistry-Lab		
MSLT-106(P)	Hematology-Lab		
<b>Practical Components</b>			
MMLT0101(P)	General Biochemistry	70	30
MMLT0102(P)	Medical Laboratory Technology	70	30
MMLT0103(P)	General Bacteriology, Immunology & Parasitology	70	30
MMLT0104(P)	Hematology & Clinical Pathology	70	30
MMLT0105(P)	General Pathology	70	30
<b>TOTAL</b>		<b>1100</b>	

**Second Year**

Course Code	Course Title	Distribution of Marks	
		Theory/ Practical	Continuous Assessment
MMLT0201	Clinical & Nutritional Biochemistry & Endocrinology	70	30
MMLT0202	Systemic Bacteriology, Virology and Mycology	70	30
MMLT0203	Advance Haematology & Immuno-Haematology	70	30
MMLT0204	Histopathology and Cytology	70	30
MMLT0205	Industrial Training-I	70	30
<b>Practical Components</b>			
MMLT0201(P)	Clinical & Nutritional Biochemistry & Endocrinology	70	30
MMLT0202(P)	Systemic Bacteriology, Virology and Mycology	70	30
MMLT0203(P)	Advance Haematology & Immuno-Haematology	70	30
MMLT0204(P)	Histopathology and Cytology	70	30
<b>TOTAL</b>		<b>900</b>	

**SYLLABUS  
FIRST YEAR**

**MSLT-101 (Fundamentals of Medical Laboratory Technology)**

**Unit -1 General Laboratory Techniques and procedures:**

Chemicals and related substance, general laboratory supplies, volumetric equipments and its calibration, centrifuges, balances and weighing, concept of solute and solvent, buffer solutions and their actions, physical and chemical units, units of measurements, safety measures.

**Unit – 2 Specimen collection and processing:**

Collection and preservation of blood and urine, sources of biological variations, pre-analytical variables.

**Analytical Techniques:**

A. Spectrophotometer, flame emission spectrophotometry, atomic absorption spectrophotometry, fluorimetry, nephelometry, turbidimetry, flow cytometry

B. Electrochemistry – potentiometry, biosensors

C. Chromatography – Theory, description of techniques of various types of chromatography, paper chromatography, HPLC

D. Electrophoresis – Theory, description of techniques of various types of electrophoresis, technical considerations

E. Immunochemical techniques – basic concepts, antigen-antibody binding qualitative methods, quantitative methods.

F. Centrifugation techniques

G. Protein purification

H. Recombinant DNA technology – PCR, western blotting, northern blotting and southern blotting.

Automation: Concepts, automation of analytical processes, integrated automation for clinical laboratory, automation of point of care analyzers.

**Unit -3:Laboratory Operation:**

- a. Selection and evaluation of methods: Basic concepts, accuracy - reference methodology, systematic error, analytical range, sensitivity and speciality, detection limit, interferences within run-precision, recovery

**Assessing method acceptability:**

- b. Establishment and use of reference value
- c. Clinical laboratory information-computer system, micro-computer applications laboratory information systems, future use of computers.

**Unit-4: Laboratory Management and Safety:**

HR and Financial Management, Space and Facility Management, Lab safety program, safety equipments, chemical hygiene, identification of laboratory hazards (chemical hazards, clinical hazards, electrical hazards, biological hazards), prevention of hazards.

Quality management: Fundamentals, total quality management, total testing process, control of pre-analytical and analytical variables, control of analytical quality using stable control materials, external quality assessment, documentation of reports, proficiency testing new quality initiatives.

## **MSLT-102-HUMAN ANATOMY & PHYSIOLOGY**

### **Unit1: Introduction**

Definition of Anatomy and Physiology, land marks of the body, common anatomical terminologies, anatomical positions & anatomical Planes, definition of Cell & Tissues, Various types of cells and tissues- a brief description of cell structure with functions of cell organelles,

### **Unit2: Skeletal System**

Introduction and definition of bone & joints, different types of bones, their structure and functions of bones, joints and their types, cartilaginous joint, fibrous joints and synovial joints, sub types of synovial joints, various types of movements at the bony joints, clinical notes

### **Unit3: Blood & Lymphatic System**

Blood as a connective tissue, composition & functions of blood, Lymph & Lymphatic System- brief overview, Clinical terminologies

### **Unit4: Cardiovascular System**

Anatomical structure of heart, Systemic or body circulation, Pulmonary or lesser circulation, cardiac cycle, cardiac output, stroke volume, heart sounds, brief description of blood supply in upper & lower limb, circle of Willis or blood supply in brain, clinical notes.

### **Unit5: Digestive System**

Introduction to digestion, brief anatomical description of various parts of the digestive system & their functions, nine regions of the abdominal cavity, an overview of the mechanism of digestion, digestive Juices, outlines of the Hepato-biliary system, clinical notes

### **Unit6: Excretory System**

Definition of excretion & excretory system, gross anatomy of Kidney, Ureters & Urinary Bladder & their functions, formation of Urine, composition .of urine, structure of nephron, clinical notes

### **Unit7: Respiratory System**

Introduction & definition of respiration, inspiration & expiration, various parts of the respiratory system & their functions with emphasis on the lungs, mechanism of gaseous exchange, clinical terminologies.

### **Units8: Reproductive System**

Introduction & definition of reproduction, brief anatomical description of the male and female reproductive system and their functions, male & female reproductive hormones, related clinical notes

### **Unit9: Endocrine System**

Definition & classification of glands, various endocrine glands & their hormones with special emphasis on pituitary gland

### **Unit10: Nervous System**

Introduction to nervous system, various parts of brain & their functions, Meninges as protective coverings of brain, different regions of brain with their specific function, C,S,F, ventricles of brain, hypothalamus as specialized contra of brain, cranial & spinal nerves

### **Unit11: The Sensory System**

Brief overview of structure & functions of eye, ear, nose, tongue & skin

**Learning Resources:** Reference Text Books, Lecture Notes and SLM

#### **List of reference books:**

1. Text Book of Human Anatomy- Dr. B.D. Chaurasia, Vol-I&II
2. A Text Book of Physiology- Dr. Chatterjee
3. Graaff, Kent Van de and et al, Schaum's Outline of Human Anatomy and Physiology: Fourth Edition, (2013), McGraw-Hill

**THEORY COMPONENT**

**Unit1. Structure of Cell and intracellular organelles**

Carbohydrates, lipids, proteins and nucleic acids – structure, classification, properties, functions and Separation techniques, Membrane structure, glycoprotein

**Unit – 2**

Enzymes: Classification, factors that alter enzymes catalyzed reaction, Michaelis – Menton Equation, Competitive and non-competitive inhibition of enzyme reactions, regulation enzyme activity, Iso-enzymes – separation and identification, plasma enzymes in clinical diagnosis. Coenzymes

**Unit – 3**

Bioenergetics and Oxidative phosphoryation; free energy-exergonic and endergonic reaction, high energy phosphates, components of electron transport chain-mechanism of ATP production, Chemiosmotic theory, inhibitor of respiratory chain

**Unit –4**

Carbohydrate Metabolism; Glycolysis, TCA cycle, glycogen, gluconeogenesis, blood glucose regulation, diabetes mellitus

Lipid Metabolism: Synthesis and breakdown of fatty acids, ketone bodies, DKA, Cholesterol, bile acids, lipoproteins, atherosclerosis.

**Unit – 5**

Protein Metabolism: Synthesis and breakdown of amino acids, urea cycle, specialized products from amino acids.

**Unit – 6**

Molecular Biology: Structure and functions DNA, organization and replication, transcription, protein synthesis. Recombinant DNA technology, PCR, FISH

**Unit – 7**

Vitamins, Water and mineral Metabolism: Functions and deficiency manifestations of Vitamin A, D, E, K, C, B complex. Water and electrolytes, calcium, phosphorus, magnesium, iron, lead, copper, trace elements (iodine, selenium, zinc).

## PRACTICAL COMPONENTS:

1. Preparation of buffers and determination of pH
2. Absorption spectra of aromatic amino acids
3. Colour reactions of aminoacids
4. Normal and abnormal constituents of urine
5. Body fluid examination
6. Qualitative analysis and identification of sugars
7. Separation of sugars by paper chromatography
8. Qualitative analysis and identification of amino acids
9. Separation of amino acids by paper chromatography, TLC
10. Separation of Lipids by TLC
11. Agarose gel electrophoresis
12. Separation of proteins, haemoglobin, lipoproteins by electrophoresis using agarose gel
13. Studies on enzyme kinetics using enzyme sources such as acid phosphatase from potatoes, alkaline phosphatase from liver – effect of pH, Temperature and substrate concentrations
14. Assessment of antioxidant status: Vitamin C and E, glutathione, MDA, Paraoxanose in serum
15. PCR
16. ELISA
17. Western blot
18. Chemi-luminescence
19. Blood gas analysis
20. Karyotyping
21. Molecular weight determination by PAGE
22. Cell fractionation
23. Protein purification by
  - a)  $\text{NH}_4\text{SO}_4$  Precipitation

**Learning Resources:** Reference Text Books, Lecture Notes and SLM

### List of reference books

1. Harper's textbook of Biochemistry
2. Principles of Biochemistry by Lehninger
3. Biochemistry by Voet and Voet
4. Molecular Biology by Griffith

### Reference Books for Practical Components

1. Practical Biochemistry – Plummer
2. Practical Biochemistry – Harold Varley
3. Tools in Biochemistry – Cooper

## **MSLT-104 CLINICAL PATHOLOGY**

### **Unit1. Introduction**

- 1.1 General introduction to pathology, causes of cell injury, cell injury and necrosis
- 1.2 Apoptosis and sub cellular responses to cell injury
- 1.3 Cellular responses to growth and differentiation, pathologic calcification
- 1.4 Acute and chronic inflammation
- 1.5 Morphologic patterns of acute and chronic inflammation
- 1.6 Systemic effects of inflammation
- 1.7 Complements and their functions
- 1.8 Cytokines and their functions
- 1.9 Intracellular accumulation, gangrene – pathology and classification
- 1.10 Pathogenesis and classification of edema
- 1.11 Reticulocyte structure
- 1.12 Pathogenesis of thrombosis, embolism, infarction and shock

### **Unit-2**

- 2.1 Control of normal growth, cell cycle illustration and the regulation of cell division
- 2.2 Labile cells, stable cells, permanent cells
- 2.3 Molecular events in cell growth (autocrine signalling, paracrine signaling, endocrine signaling)
- 2.4 Cell surface receptors, signal transduction systems and transcription factors.
- 2.5 Growth inhibition, growth factors, extra cellular matrix and cell matrix interactions
- 2.6 Collagen, elastin, fibrillin and elastic fibres, adhesive glycoproteins and integrins
- 2.7 Matricellular proteins, proteoglycans and Hyaluronidase.
- 2.8 Repair by connective tissue-angiogenesis, growth factors and receptors for angiogenesis
- 2.9 Extra cellular matrix proteins as regulators of angiogenesis.
- 2.10 Fibrosis, tissue modelling, wound healing, healing by first and second intention
- 2.11 Haemo dynamic disorders – Hemostasis and thrombosis.

### **Unit3. Genetics**

- 3.1 Genetics (molecular basis of human diseases, production of human biologically active agents)
- 3.2 Gene therapy, disease diagnosis, mutations
- 3.3 Mendelian disorders, autosomal dominant disorders, autosomal recessive disorders and X linked disorders
- 3.4 Biochemical and molecular basis of single gene disorders.
- 3.5 Disorders with multifactorial inheritance, normal karyotype
- 3.6 Fluorescence in situ hybridization, cyto genetic disorders involving sex chromosomes.
- 3.7 Diagnosis of genetic diseases
- 3.8 Direct gene diagnosis, indirect gene diagnosis, linkage analysis

### **Unit4. Neoplasia & Cancer**

- 4.1 Neoplasia, Nomenclature, characteristics of benign and malignant neoplasms
- 4.2 Molecular basis of cancer, oncogenes and cancer, protein products of oncogenes
- 4.3 Activation of Oncogenes
- 4.4 Point mutations, chromosomal rearrangements, gene amplification
- 4.5 Cancer suppressor genes, protein products of tumor suppressor genes.
- 4.6 Molecules that regulate nuclear transcription and cell cycle, Rb gene, P53 gene, BRCA-1 and BRCA-2 gene
- 4.7 Molecules that regulate signal transduction, cell surface receptors
- 4.8 Other tumour suppressor genes
- 4.9 Genes that regulate apoptosis and DNA repair
- 4.10 Telomeres and cancer, molecular growth, Kinetics of tumour cell growth, tumor angiogenesis
- 4.11 Lab diagnosis of cancer.

## Unit5 Infectious Diseases

- 5.1 Infectious diseases, new and emerging infectious diseases, categories of infectious diseases in brief
- 5.2 Special techniques for diagnosing infections
- 5.3 Tuberculosis-etiology, pathogenesis and lab diagnosis
- 5.4 Leprosy – etiology, pathogenesis and lab diagnosis
- 5.5 HIV- epidemiology, pathogenesis and lab diagnosis

### Practicals

1. Polymerase chain reaction
2. In situ hybridization
3. Cytogenetics
4. Western blot
5. Northern blot
6. Southern blot
7. CD4 CD8 counts

### Systemic pathology

1. PAS (Periodic Acid-Schiff)
2. Stain Romanowsky stain
3. Stain for micro-organisms
4. Argentaffin and argyrophil stains Amyloid stains
5. Reticulin stains
6. Trichrome stains
7. Phosphotugstic acid hematoxylin stain (PTAH)
8. Stains for hemodierin (Perls), melanin (Fontana) and calcium (von Kossa)
9. Stains for neutral lipids
10. Mucin stains Glemsa stain Elastic fibers Myelin stains
11. Enzyme histochemistry and immunoenzyme technique
12. Immunohistochemistry and the various immunohistochemical stains in the diagnosis of various disorders
13. Tissue of special interest – nervous system Hard tissue
14. Miscellaneous cells
15. Endocrine cells
16. Cytology technique
17. Quantitative methods
18. Autoradiography (specimen radiography)
19. Micro incineration
20. Museum technique
21. Specimen photography and microphotography

### Microscopy

- General microscopy
- Dark ground microscopy
- Immunofluorescence and fibers and formaldehyde induced fluorescence
- Fluorescence microscopy
- Polarizing microscopy
- Phase contrast microscopy
- Electron microscopy



## SECOND YEAR

### MSLT-201 (CLINICAL & NUTRITIONAL BIOCHEMISTRY & ENDOCRINOLOGY)

#### SECTION-A CLINICAL BIOCHEMISTRY

##### Unit -1

Clinical Enzymology: Enzymes in plasma and their origin, general principles of assay, clinical significance of enzymes and isoenzymes, Measurement of serum enzymes in diagnosis – cardiac and skeletal muscle enzymes, liver and biliary tract enzymes digestive, bone and gi disorders.

##### Unit-2 Metabolic Disorders

**Disorders of carbohydrate Metabolism:** diabetes mellitus – diagnosis, gestational diabetes mellitus, role of laboratory in diagnosis and prognosis in diagnosis and prognosis, hypoglycemia. Determination of glucose in body fluids, ketone bodies, lactate and pyruvate. Glycated proteins, urinary albumin excretion –specimen collection, storage and quantitative assay. Qualitative tests for individual sugars in urine. Inborn errors of metabolism

**Disorders of Lipid Metabolism:** Atherosclerosis and coronary artery disease. Disorders of lipoprotein metabolism. Measurement of lipids, lipoproteins and apolipoproteins. Sources of analytical and biological variations in measurements.

**Disorders of protein Metabolism:** plasma proteins, proteins in body fluids. Analysis of proteins n blood and other body fluids. Electrophoresis of plasma proteins. Aminoacidurias-selected disorders of amnoacid metabolism-phenylalanine, tyrosine, alkaptonuria, melanuria, cystinula, homocystinuria, cystinosis, organic acidurias. Analysis of amino acids – screening test, quantitative tests for specific aminoacids.

##### Unit-3: Organ Dysfunctions

Disease related to organs: Liver- LFT, Jaundice, hepatitis, cholestasis

Kidney- RFT, renal failure, uremia, nephritic syndrome, renal calculi, renal tabular acidosis, diabetes insipidus, dialysis. Early makers of renal pathology – mircoalbuminuria, albumin: creatinine ratio.

GIT- Gastric and pancreatic function tests, pancreatitis, malabsorption syndrome.

##### Unit – 4

Electrolytes and blood gas analysis – specimens for electrolyte determination- sodium, potassium, chloride, bicarbonate, determination of pCO<sub>2</sub>, O<sub>2</sub> and pH.

##### Unit – 5

Miscellaneous topics: Composition of CSF, meningitis, encephalitis, cancer, oncogenes, tumour markers, AIDS- basic concepts, diagnosis, Cytokinetics.

**SECTION-B**  
**NUTRITIONAL BIOCHEMISTRY & ENDOCRINOLOGY**

**Unit – 1**

General concepts of endocrinology- the endocrine system, hormones- chemical nature, classification, hormonal action- receptors, hormone receptor interaction, regulation of gene expression by hormones, second messengers (camp, GMP, Ca++) Protein kinase cascade. Concepts of hormones assay.

**Unit- 2**

Hypothalamus and pituitary- anatomy, chemistry, functions, regulation. Diseases related to the hormones of these glands. Assessment of anterior and posterior pituitary.

**Unit – 3**

Thyroid anatomy, chemistry, synthesis, functions, regulation, thyroid function test in various abnormal conditions, parathyroid – anatomy, chemistry, synthesis, functions, regulations, diseases of parathyroid glands. Hormones involved in calcium and phosphate metabolism. Diseases related to its metabolism. Calcium chemistry and functions.

**Unit- 4**

Adrenal cortex and medulla – anatomy, chemistry, synthesis, metabolic effects, pathophysiology of the adrenal cortex. Assessment of adrenal functions, Gonadal hormones – anatomy, chemistry, functions, regulations and diseases related to these glands. Endocrinology of male and female infertility, pregnancy and lactation.

**Unit – 5**

Gastrointestinal and pancreatic hormones – chemistry, synthesis, metabolic effects, regulation, diseases related to the hormones of these glands. Detection of anomalies.

**Unit - 6**

Nutritional requirements of carbohydrates, proteins and lipids. Deficiency states of carbohydrates, proteins and lipid. RDA, Nutritional requirements of vitamins (fat and water soluble)- Structure, functions, deficiency states, dietary source, Nutritional requirements of macro and microelements-functions, deficiency states, dietary source, RDA.

**PRACTICALS**

**PROCEDURES USING AUTOMATED ANALYZERS**

1. Estimation of blood glucose, GT, glycated haemoglobin, fructosamine, urine microalbumin.
2. RFT- Estimation of blood urea, serum creatinine, uric acid, GFR, urinary proteins, protein, Creatinine ratio.
3. LFT – Estimation of total bilirubin, total protein, albumin, SGOT, SGPT, ALP, GGT
4. Lipid profile- total cholesterol, triglycerides, HDL, LDL
5. Cardiac enzymes – creatinine kinase, CK- MB, LDH
6. Pancreatic function tests – amylase.
7. Estimation of calcium, phosphorous, magnesium, iron
8. Electrolytes
9. Quantitative analysis of urine- protein, uric acid, creatinine, calcium chloride
10. Analysis of CSF
11. Hormones: Thyroid profile- FT2, FT4, TSH, Fertility profile – LH, FSH, prolactin, estradiol, testosterone; cortisol, insulin
12. Tumor markers : P:SA
13. CAD risk assessment: Apo A, Apo B 100, hs Homocysteine, Lp(a)

## **MSLT-202 (SYSTEMIC BACTERIOLOGY, VIROLOGY AND MYCOLOGY)**

### **SECTION-A SYSTEMIC BACTERIOLOGY**

#### **Unit – 1**

Gram positive cocci- staphylococci, pneumococci, streptococci  
Gram Negative cocci – N. Gonorrhoeae, N. meningitides

#### **Unit – 2**

Gram positive bacilli- corynebacteria, Mycobacteria, Clostridia, Actinomycetes Bacillus Anaerobes

#### **Unit- 3**

Gram negative bacilli – Enterobacteriaceae, Pseudomonas, Vibria Brucella, Bordetella, Haemophilus, Yersinia

#### **Unit – 4**

Spirochetes – Treponema, Leptospira, Borrelia  
Rickettsiae, Chlamydiae, Miscellaneous bacteria

### **PRACTICALS**

1. Introduction of Clinical specimen, identification of bacteria, staining methods Biochemical tests, antibiotic sensitivity testing
2. Darkground microscopy, special staining methods, use of experimental animals Food milk and water bacteriology
3. Air Sampling and theatre sterility

### **SECTION-B VIROLOGY**

#### **Unit – 1**

Classification and general properties of viruses – interferon, inclusion bodies  
Cultivation of viruses and laboratory diagnostic methods of viral diseases

#### **Unit – 2**

Pox virus, herpes virus, myxoviruses, enteroviruses

#### **Unit - 3**

Rabies, Arbo viruses, hepatitis, HIV, viruses causing gastro enteritis, miscellaneous viruses

#### **Practicals**

Tissue culture methods  
Fluorescent microscopy, ELISA, PCR

### **SECTION-C MYCOLOGY**

#### **Unit – 1**

General properties of fungi, cultivation methods, laboratory methods of diagnosing fungal infection.

#### **Unit - 2**

Superficial and deep fungal infections, opportunistic fungal infection  
Mycotoxins

#### **Practicals**

Identification of fungi, microscopy, culture, special staining methods

## **MSLT-203 (ADVANCED HAEMATOLOGY AND IMMUNOHAEMATOLOGY)**

1. Coagulation disorders and basics of their work up Thrombotic disorders and basics of testing
2. Automated cell counters and coagulation analysers – principles Manual Haemoglobin and Counts
3. Peripheral smear –Preparation and Interpretation Manual tests of coagulation, factor assays
4. Urine and stool – analysis, micro and interpretation Immunohaematology Genetics and immunology  
ABO and Rh blood group system
5. Other major blood group systems – clinical significance of Compatibility testing
6. Antibody screening and identification
7. Clinical significance of Choice of reagents and QA of the same
8. Donor Screening and bleeding
9. Blood bags, Anticoagulant and preservative solutions Blood
10. Components – preparation, Quality control Apheresis
11. Infectious disease screening
12. Transfusion reactions, Haemolytic Disease of the Newborn, appropriate use of blood
13. Choice of blood in specific clinical scenarios – HDN, Multiply transfused etc Basics of HLA  
typing and anti HLA antibody detection

## **MSLT-204 (HISTOPATHOLOGY AND CYTOLOGY)**

### **Unit -1**

PAS (Periodacid – Schiff) Stain

Stain for micro-organisms

Argentaffin and argyrophil stains

Amyloid stains

Reticulin Stains

Trichrome stains

Posphotugstic acid hematoxylin stain (PTAH)

Stains for hemosiderin, Melanin and CA

Stains for neural lipids

Mucin stains

Giemsa Stain

Elastic stain

Myelin stain

Romanowsky stain

### **Unit - 2**

Enzyme histochemistry and immunoenzyme techniques

Immunohistochemistry and the various immunohistochemical stains in the diagnosis of various -disorders

Tissues of special interest – nervous system

Hard tissue

Miscellaneous cells

Endocrine cells

### **Unit – 3**

Cytology techniques

Quantitative methods

Micro incineration

### **Unit – 4**

Autoradiography

Museum tech

Specimen photography and microphotography

### **Unit -5**

Microscopy

General Microscopy

Dark ground microscopy

Immunofluoresence