

Syllabus
For
B.Sc.
in Medical Laboratory Technology
(B.Sc.-MLT)
Academic Programme

Duration :
3 years & 6 months internship

DURATION OF COURSE :

- B.Sc. in Medical Laboratory Technology course will be a full time course.
- Duration will be three years followed by compulsory 6 months rotatory internship.
- This course shall be divided into three professional examinations namely B.Sc. in Medical Laboratory Technology (B.Sc.-MLT) Part-I at the end of first academic year, B.Sc.-MLT Part-II at the end of second academic year and B.Sc.-MLT Part-III at the end of third academic year.

EXAMINATION :

- There shall be an annual university examination at the end of each academic year in the form of theory papers and practical examinations. The candidate shall be required to appear in every subject as specified in the course structure for each year.

Duration of Examination :

- Each theory paper shall be of three hours duration.

Scheme of Examination :**B.Sc. in Medical Laboratory Technology Part-I (First Year) University Examination**

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1	General Pathology & General Microbiology	MLT-101	40	10	50	25	40	10	50	25	100
2	Hematology	MLT-102	40	10	50	25	40	10	50	25	100
3	Fundamentals of Anatomy & Physiology	MLT-103	40	10	50	25	40	10	50	25	100
4	Basics of Biochemistry, Clinical Pathology, Instruments & Reagents	MLT-104	40	10	50	25	40	10	50	25	100
Grand Total											400

B.Sc. in Medical Laboratory Technology Part-II (Second Year) University Examination

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1	Blood Bank Procedures & Hemoglobinopathies	MLT-201	40	10	50	25	40	10	50	25	100
2	Endocrinology, Tumor & Cancer Markers	MLT-202	40	10	50	25	40	10	50	25	100
3	Clinical Biochemistry	MLT-203	40	10	50	25	40	10	50	25	100

4	Immunology, Serology & Parasitology	MLT-204	40	10	50	25	40	10	50	25	100
Grand Total											400

B.Sc. in Medical Laboratory Technology Part-III (Third Year) University Examination

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1	Histopathology & Cytology techniques	MLT-301	40	10	50	25	40	10	50	25	100
2	Coagulation studies	MLT-302	40	10	50	25	40	10	50	25	100
3	Systemic bacteriology, Mycology & Virology	MLT-303	40	10	50	25	40	10	50	25	100
4	Quality Laboratory Management & Automation	MLT-304	40	10	50	25	40	10	50	25	100
Grand Total											400

INTERNAL ASSESSMENT

- It will be for theory and practical both.
- It will be done through the whole year.
- Candidate must obtain at least 35% marks in theory and practicals separately in internal assessment to be eligible for the annual university examination.
- Internal assessment (Theory) will be done as follows :
 - a) Mid-term and term examinations = 10 marks
 - b) Assignments/Projects/Class test/Clinical Presentations = 05 marks
 - c) Attendance = 05 marks

Total = 20 marks

Internal assessment (Practical) will be done as follows :

- a) Laboratory manual = 10 marks
 - b) Day to day performance = 05 marks
 - c) Attendance = 05 marks
- Total = 20 marks**

CRITERIA FOR PASSING

- A candidate is declared to have passed University examination in a subject, if he/she secures 50% of the marks in theory and 50% in practicals separately. For computation of 50% marks in theory, the marks scored in the internal assessment (theory) shall be added to the University conducted written examination and for passing in practical the marks scored in University conducted practical examination and internal assessment (practical) shall be added together.

GRACE MARKS:

- If a candidate fails in one subject (theory only) in the annual University examination, five grace marks will be given to the candidate by the University before the declaration of result.
- Candidate failing in practical examination will be considered as failed.

SUPPLEMENTARY EXAMINATION:

- A candidate failing in a subject but securing at least 30% aggregate marks will be required to appear in the university examination after 3 months in that subject/ subjects while attending classes of next year. Those who secure less than 30% aggregate marks will be required to appear in all the subjects.
- If the candidate fails in supplementary examination his/her session will be shifted by one year. The candidate will have to take admission in the previous year and pay the tuition fee for the academic year. He/she will have to appear in all the subjects in the examination.

- Supplementary examination will be held not earlier than 3 months and later than 6 months from the date of annual University examination.

DIVISION:

- Candidate will be awarded division at the end of 3rd academic year as follows:
 - Distinction - 75% and above marks in any subject.
 - First division - 60% and above in the aggregate of marks of all subjects
 - Second division- 50% or more but less than 60% in the aggregate of marks of all subjects.

INTERNSHIP

- A candidate will have to undergo internship for a period of six calendar months in a medical college/hospital equipped with modern pathology laboratory facility or in a fully equipped pathology laboratory, which fulfills the norms decided by the University.

DEGREE:

- The degree of B.Sc. in Medical Laboratory Technology (B.Sc.-MLT) course of the University shall be conferred on the candidates who have pursued the prescribed course of study for not less than three academic years and have passed examinations as prescribed under the relevant scheme and completed 6 months of compulsory rotatory internship.

COURSE OF STUDY

B.Sc. in Medical Laboratory Technology Part-I (First Year)

Sl.	Subjects	Teaching hours		
		Theory	Practicals	Total
1	General Pathology & General Microbiology	100	100	200
2	Hematology	80	80	160
3	Fundamentals of Anatomy & Physiology	100	100	200
4	Basics of Biochemistry, Clinical Pathology, Instruments & Reagents	100	100	200
5*	English	40	-	40
6*	Computer	30	30	60

*Not included for university examination.

B.Sc. in Medical Laboratory Technology Part-II (Second Year)

Sl.	Subjects	Teaching hours		
		Theory	Practicals	Total
1	Blood Bank Procedures & Hemoglobinopathies	80	80	160
2	Endocrinology, Tumor & Cancer Markers	60	140	200
3	Clinical Biochemistry	100	100	200
4	Immunology, Serology & Parasitology	100	100	200
5.*	Clinical Training (in a medical college/100 bedded hospital with well equipped pathology laboratory for at least one month)	-	160	160

* Not included for university examinations.

B.Sc. in Medical Laboratory Technology Part-III (Third Year)

Sl.	Subjects	Teaching hours		
		Theory	Practicals	Total
1	Histopathology & Cytology techniques	80	80	160
2	Coagulation studies	80	80	160
3	Systemic bacteriology, Mycology & Virology	120	80	200
4.	Quality Laboratory Management & Automation	60	140	200
5*.	Clinical Training (in a medical college/100 bedded hospital with well equipped pathology laboratory for at least one month on rotatory basis in various sections of pathology & microbiology lab.)			160

*Not included for University Examination

INTERNSHIP

- There shall be six months of Internship after the final year examination for candidates declared to have passed the examination in all the subjects.
- During the internship candidate shall have to work full time average 7 hours per day (each working day) for 6 Calendar months.
- Each candidate is allowed maximum of 6 holidays during entire Internship Program and in case of any exigencies during which the candidate remains absent for a period more than 6 days, he/she will have to work for the extra days during which the candidate has remained absent.
- The Internship should be rotatory and cover Haematology, Histology & Cytology, Biochemistry, Microbiology, Endocrinology & Automation sections of Pathology laboratory.
- Based on the attendance and work done during posting the Director/Principal/ head of institution/department shall issue '**Certificate of Satisfactory Completion**' of training following which the University shall award the B.Sc. in Medical Laboratory Technology Degree or declare the candidate eligible for the same.
- **No candidate shall be awarded degree without successfully completing six months internship.**
- Institution shall have to satisfy themselves that satisfactory infrastructure facilities of Pathology Laboratory exist in the Institute / Hospital where the internship training has to be undertaken. Following parameters / guidelines have been suggested:
 - a. It is mandatory for the Institution to have its own well equipped and modern pathology laboratory.
 - b. Senior Pathologist should manage the pathology laboratory in the Institutes/Hospitals.
- Institute's Director / Principal can at his discretion grant NOC to the students to do the Internship at the place of his choice provided the concerned Hospital/Pathology Laboratory fully satisfies the above criteria. For the purpose of granting NOC the candidate shall have to submit to the Institution the status of Pathology Laboratory services available at the place where he intends to do his Internship.

B.Sc. in Medical Laboratory Technology (B.Sc.-MLT) First Year

GENERAL PATHOLOGY & GENERAL MICROBIOLOGY

Subject Code : MLT-101

Min. Hrs - Theory : 100 Hrs. & Practical : 100 Hrs.

THEORY

GENERAL PATHOLOGY

1. Cell Injury and Cellular Adaptations.

- a) Normal Cell
- b) Cell Injury- types of cell injury, etiology of cell injury, morphology of cell injury, cellular swelling.
- c) Cell death : types- autolysis, necrosis, apoptosis & gangrene.
- d) Cellular adaptations-atrophy, hypertrophy, hyperplasia & dysplasia.

2. Inflammation

- a) Acute inflammation - vascular event, cellular event, inflammatory cells.
- b) Chronic Inflammation - general features, granulomatous inflammation, tuberculoma.

3. Haemodynamic Disorders :

Oedema, hyperemia, congestion, haemorrhage, circulatory disturbances, thrombosis, ischaemia & infarction .

4. Neoplasia :

Definition, how does it differ from hyperplasia, difference between benign tumor and malignant tumor.

5. Healing

Definition, different phases of healing, factors influencing wound healing.

GENERAL MICROBIOLOGY

1. General characters and classification of Bacteria.

2. Characteristics of Bacteria

Morphology - Shape, Capsule, Flagella, Inclusion, Granule, Spore.

3. Growth and Maintenance of Microbes

Bacterial division, Batch Culture, Continuous culture, bacterial growth- total count, viable count, bacterial nutrition, oxygen requirement, CO₂ requirement, temperature, pH, light.

4. Sterilization and Disinfection.

Physical agents- Sunlight, Temperature less than 100⁰C, Temperature at 100⁰C, steam at atmospheric pressure and steam under pressure, irradiation, filtration.

Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.

5. Culture Media

Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Sugar Media, Anaerobic Media, Containers of Media, Forms of Media

6. Staining Methods

Simple, Grams staining, Ziehl-Neelsen staining or AFB staining, Negative Impregnation

7. Collection and Transportation of Specimen

General Principles, Containers, Rejection, Samples- Urine, Faeces, Sputum, Pus, Body fluids, Swab, Blood.

8. **Care and Handling of Laboratory Animals**
Fluid, Diet, Cleanliness, Cages, ventilation, Temperature, Humidity, handling of Animals, Prevention of disease.
9. **Disposal of Laboratory/Hospital Waste**
Non-infectious waste, Infected sharp waste disposal, infected non-sharp waste disposal.

PRACTICAL

GENERAL PATHOLOGY

1. Components & setting of the Compound microscope.
2. Focusing of object.
3. Use of low & high power objectives of microscope.
4. Use of oil immersion lens.
5. Care and Maintenance of the microscope.
6. Different types microscopy
 - Dark field microscopy
 - Fluorescence Microscopy
7. Electronic Microscopy in brief.

GENERAL MICROBIOLOGY

1. Preparation of swabs/sterile tubes & bottles.
2. Preparation of smear.
3. Staining.: Gram & Ziehl -Neelsen staining.
4. Identification of Culture media.
5. Identification of instruments.
6. Identification of common microbes.

HEMATOLOGY

Subject Code : MLT-102

Min. Hrs. - Theory :80 Hrs. & Practical : 80 Hrs.

THEORY

1. **Hematological Disorders**
 - a. Classification of Anemia : Morphological & etiological.
 - b. Iron Deficiency Anemia : Distribution of body Iron, Iron Absorption, causes of iron deficiency, lab findings.
 - c. Megaloblastic Anemia : Causes, Lab findings.
 - d. Hemolytic Anemia : Definition, causes, classification & lab findings.
 - e. Bone Marrow : Cell composition of normal adult Bone marrow, Aspiration, Indication, Preparation & Staining, Special Stain for Bone Marrow -Periodic Acid Schiff, Sudan Black, Myeloperoxidase.
 - f. Leukemia : Classification, Blood Picture, Differentiation of Blast Cells.

2. Basic Hematological Techniques

- a. Characteristics of good technician
- b. Preparation of specimen collection material.
- c. Lab. request form.
- d. Basic steps for drawing a blood specimen by veinipuncture. Complications of veinipuncture.
- e. Patient after care
- f. Specimen rejection criteria for blood specimen
- g. Hemolysis of blood
- h. Blood collection by skin puncture (Capillary Blood)
- i. Arterial puncture.
- j. Deciding specimen types and selection of -
 - o Anticoagulant- EDTA, Citrate, Oxalate, Heparin, sodium fluoride.
- k. Separation of serum
- l. Separation of plasma
- m. Changes in blood on keeping
- n. Maintenance of specimen identification
- o. Transport of the specimen.
- p. Effect of storage on Blood Cell Morphology
- q. Universal precautions

PRACTICAL

1. Basic requirements for hematology laboratory.
2. Glasswares for Hematology.
3. Equipments for Hematology.
4. Anticoagulant vial preparation.
5. Complete Blood Counts.
6. Determination of Hemoglobin.
7. TRBC Count by Hemocytometers.
8. TLC by Hemocytometer.
9. Differential Leukocyte count.
10. Determination of Platelet Count.
11. Determination of ESR by wintrobes.
12. Determination of ESR by Westergeren's method.
13. Determination of PCV by Wintrobes.
14. Erythrocyte Indices- MCV, MCH, MCHC.
15. Reticulocyte Count.
16. Absolute Eosinophil Count.
17. Morphology of Red Blood Cells.

FUNDAMENTALS OF ANATOMY & PHYSIOLOGY

Subject Code : MLT-103

Min. Hrs. - Theory :100 Hrs. & Practical : 100 Hrs.

THEORY

ANATOMY :

1. General Anatomy

- a) Cell - structure & function
- b) Tissue
 - Epithelium
 - Connective
 - Sclerous
 - Muscular
 - Nervous
- c) Lymphatic System

2. Systemic

Basic Features of :

- a) Cardiovascular system
- b) Respiratory system
- c) Digestive system
- d) Excretory system
- e) Genital (Male & Female) system
- f) Nervous system

PHYSIOLOGY

1. Cell : Structure & function

2. Blood

- a) Blood cells
- b) Haemoglobin
- c) Blood groups
- d) Coagulation Factors
- e) Anaemia & Immunoglobulins

3. Cardiovascular system

Heart rate, cardiac cycle, cardiac output, blood pressure, hypertension, radial pulse

4. Respiratory System

- a) Ventilation
- b) Functions
- c) Lungs Volumes and capacities

5. Gastrointestinal System

Process of digestion in various parts

6. Endocrinology

- a) List of Endocrine Glands
- b) Hormones : Their secretion and functions (in brief)

7. Excretion system

- a) Structure of nephron
- b) Urine formation

8. Central Nervous System

- a) Parts
- b) Sliding Filament Theory
- c) Neuro Muscular Junction
- d) Wallerian Degeneration
- e) Motor Nervous system
 - Upper motor neuron system
 - Lower motor neuron system
- f) Sensory nervous system
- g) Sympathetic Nervous system
- h) Parasympathetic nervous system

9. Skin - Function & Structure

10. Muscular System

Classification of muscles & their functions

11. Special Senses - Eye & ear (in brief)

PRACTICAL

ANATOMY

1. Identification and description of all anatomical structures.
2. The learning of Anatomy is by demonstration only through dissected parts, slides, models, charts etc.
3. Demonstration of dissected parts (upper extremity, lower extremity, thoracic & abdominal viscera, face and brain).
4. Demonstration of skeleton - articulated and disarticulated.

PHYSIOLOGY

1. Measurement of pulse, blood pressure.
2. Elicitation of Reflexes & jerks.
3. Identification of blood cells by study of peripheral blood smear.

BASICS OF BIOCHEMISTRY, CLINICAL PATHOLOGY, INSTRUMENTS & REAGENTS

Subject Code : MLT-104

Min. Hrs. - Theory :100 Hrs. & Practical : 100 Hrs.

THEORY

1. Chemistry of carbohydrates & their related metabolism -

Introduction, definition, classification, biomedical importance & properties.

Brief outline of metabolism :

Glycogenesis & glycogenolysis (in brief), Glycolysis, citric acid cycle & its significance, HMP shunt & Gluconeogenesis (in brief), regulation of blood glucose level.

2. Amino acids - Definition, classification, essential & non essential amino acids.

3. Chemistry of Proteins & their related metabolism -

Introduction, definition, classification, biomedical importance.

Metabolism :

Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle, metabolic disorders in urea cycle, catabolism of amino acids especially Phenylalanine, Tyrosine & Tryptophan, Creatine, Creatinine, Proteinuria.

4. Chemistry of Lipids & their related metabolism -

Introduction, definition, classification, biomedical importance, essential fatty acids.

Brief outline of metabolism :

Beta oxidation of fatty acids, fatty liver, Ketosis, Cholesterol & its clinical significance, Lipoproteins in the blood composition & their functions in brief, Atherosclerosis.

5. Enzymes -

Introduction, definition, classification, coenzymes, isoenzymes, properties, factors affecting enzyme action, enzyme inhibition, diagnostic value of serum enzymes - Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc.

6. **Acid base balance concepts & disorders** - pH, Buffers, Acidosis, Alkalosis

7. **Hyperglycemia & hypoglycemia** -

Diabetes mellitus - definition, types, features, gestation diabetes mellitus , glucose tolerance test, glycosurias,

Hypoglycemia & its causes

PRACTICAL

1- Introduction

Aim, basis, interpretation, safety in clinical biochemistry Laboratory

2- Laboratory organisation

Instruments, glassware, sample collection & specimen labeling, routine tests, anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization of methods, preparation of solution & interpretation of result, normal values.

3- Identification of Carbohydrates (qualitative tests).

3- Identification of Proteins (qualitative tests).

4- To study general properties of the enzyme (Urease) & Achromatic time of Salivary amylase.

5- Urine analysis – normal & abnormal constituents of urine.

6- CSF & Semen Analysis - Gross & Microscopic.

7- Glucose tolerance test & Glycosylated haemoglobin.

8- Centrifugation : Principle, types & applications.

9- Chromatography : Definition, types, RF value, description of paper chromatography & applications.

10- Uses, Care and Maintenance of various instruments of the laboratory.

ENGLISH

(Not for university Examination)

Min. Hrs - Theory : 40 Hrs.

1. Introduction:

Study techniques, Organisation of effective note taking and logical processes of analysis and synthesis, the use of the dictionary, enlargement of vocabulary & effective diction.

2. Applied Grammar:

Correct usage, the structure of sentences, the structure of paragraphs.

3. Written Composition:

Precise writing and summarising, writing of bibliography, enlargement of vocabulary.

4. Reading and comprehension

Review of selected materials and express oneself in one's words, enlargement of vocabulary.

5. The study of various forms of composition paragraph, essay, letter, summary, practice in writing.

6. Verbal communication:

Discussions and summarization, debates, oral reports, use in teaching.

COMPUTER
(Not for university Examination)
Min. Hrs - Theory : 30 Hrs., Practical : 30 Hrs.

1. Basics of computer
2. Hardware and software
2. Input and output devices
3. Operating system – DOS, etc
4. Internet-
Email, social networking, application in medicine, browsing journals and article using internet .

B.Sc. in Medical Laboratory Technology (B.Sc.-MLT) Second Year

BLOOD BANK PROCEDURES & HEMOGLOBINOPATHIES

Subject Code : MLT-201

Min. Hrs. - Theory : 80 Hrs. & Practical : 80 Hrs.

THEORY

1. Blood Grouping

- Introduction
- Human Blood Group system
- ABO Subgroups
- Red Cell Antigen
- Natural Antibodies
- Rh System
- Rh Antigens & Rh Antibodies
- Hemolytic Disease of Newborn & Prevention
- Principal of Blood grouping, antigen-antibodyreaction.
- Agglutination, Haemagglutination, Condition required for antigen antibody reaction.
- Blood grouping techniques, Cell grouping, Serum grouping.
- Methods for ABO grouping. Slide & Tube Method, Cell grouping, Serum grouping, Rh grouping by slide & tube method.
- Difficulties in ABO grouping.
- Rouleaux formation, how it interfere with Blood grouping.
- Auto agglutinins.
- Antiserum used in ABO test procedures, Anti –A, Anti-B Anti- AB Antiserum.
- Inheritance of the Blood groups.
- Control, A&B Cells preparation, Auto control.
- Medical applications of Blood groups.

2. Blood Transfusion

- Principal & Practice of blood Transfusion.
- Blood Transfusion service at District level.
- Guide lines for the use of Blood, Appropriate use of Blood, Quality Assurance.

- Antilogous Blood Transfusion practices.
- Objectives of Quality Assurance in Blood Transfusion services, Standard operating procedures for usage, donation & storage of blood, screening of donor, compatibility testing, safety, procurement of supplies.

3. Blood Donation

- Introduction
- Blood donor requirements
- Criteria for selection & rejection
- Medical history & personal details
- Self-exclusion.
- Health checks before donating blood.
- Screening for TTI.

4. Blood Collection

- Blood collection packs.
- Anticoagulants.
- Taking & giving sets in Blood transfusion.
- Techniques of collecting blood from a doctor.
- Instructions given to the donor after blood donation.
- Adverse donor reaction.

5. Testing Donor Blood

- Screening donor's blood for infectious agents - HIV, HCV, HBV, Trepanoma palladium, Plasmodium, HTLV.
- Bacterially contaminated Blood.

6. Blood Donor Records

- Blood donation record book.
- Recording results.
- Blood donor card.

7. Storage & Transport

- Storage of blood.
- Changes in blood after storage.
- Gas refrigerator.
- Lay out of a blood bank refrigerator
- Transportation.

8. Maintenance of Blood Bank Records

- Blood bank temperature sheet.
- Blood bank stock sheet.
- Blood transfusion request form.

9. Compatibility Testing

- Purpose
- Single tube compatibility techniques using AHG reagent.
- Emergency compatibility testing.
- Difficulties in cross matching.
- Labeling & Issuing cross- matched blood.

10. Blood Components

- Collection of blood components for fractional transfusion.

- Platelets packed Red Cell, Platelet rich Plasma, Platelets concentrate.
- Preparation of concentrated (packed) Red cells.
- Techniques of preparation.

11. Blood Transfusion Reactions

- Investigation of a Transfusion reaction.
- Hemolytic transfusion reaction.
- Actions to take when transfusion reaction occurs.

PRACTICAL

- Blood grouping & Cross Matching

ENDOCRINOLOGY, TUMOR & CANCER MARKERS

Subject Code : MLT-202

Min. Hrs. - Theory : 60 Hrs. & Practical : 140 Hrs.

THEORY

ENDOCRINOLOGY

1. Introduction
2. Difference between hormones and enzymes.
3. Classification of hormones.
4. Regulation and general mechanism of action of hormones.
5. Pituitary gland & hypothalamus
6. Hormones of the Anterior Pituitary- Growth hormone, Prolactin, Gonadotropin, Follicle Stimulating hormone, Leuteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotrophic hormone (ACTH)
7. Hormones of neurohypophysis- Oxytocin, Antidiuretic hormone (ADH)
8. Hormones of the Thyroid gland- chemistry and normal physiology, Thyroid disorders-goiter, myxedema, autoimmune thyroiditis, tumors of the thyroid gland, hyperthyroidism, Graves disease, Calcitonin, Parathyroid Hormone (PTH)
9. Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addison's disease, Glucocorticoids & functions, Mineralocorticoids & functions, Cortisol & functions, Cushing's syndrome, Conn's syndrome.
10. Adrenal medulla-metabolism of catecholamines
11. Hormones of the gonads -
Testosterone, Estrogens, Progesterone, their synthesis and functions.
Human Chorionic Gonadotropin (HCG), hormone, menstrual cycle, Menopause
12. Hormone of pancreas - Insulin- its metabolic effects on carbohydrates, fats & protein, control of insulin secretion, Glucagon- functions, metabolic effects, blood glucose regulation, Diabetes Mellitus, Somatostatin.
13. Hormone of kidney - Renin

TUMOR & CANCER MARKERS:

1. Introduction.
2. The Carcinogens-definition.
3. Oncogene-definition-
Mechanism of action of Oncogenes (outline).
4. Characteristics of growing tumor cells-general and morphological changes, biochemical changes.
5. Tumor Markers-
Introduction and definition

6. Clinical applications of tumor markers.
7. Enzymes as tumor markers, Alkaline Phosphatase (ALP), Creatine kinase (CK), Lactate dehydrogenase (LDH), Prostatic acid phosphatase (PAP), Prostate specific antigens (PSA).
8. Hormones as tumor markers (introduction of each type in brief).
9. Oncofetal antigens.
10. Alpha feto protein (AFP)
11. Carcino embryonic antigen (CEA)
12. Squamous cell carcinoma (SCC) antigen.
13. Carbohydrate markers (brief introduction of each type)
CA 15-3, CA 125

14. Blood group antigen (brief introduction of each type)
CA 19-9, CA 50, CA 72-4, CA 242
15. Bladder cancer markers (introduction in brief) -
Bladder tumor antigen (BTA)
16. Fibrin- Fibrinogen degradation product (FDP).
17. Nuclear matrix protein (NMP22).
18. Biomarkers still in research (introduction in brief)-
Telomeres, TRAP assay, hyaluronic acid and Hyaluronidase

PRACTICALS

ENDOCRINOLOGY

1. Estimation of T3
2. Estimation of T4
3. Estimation of TSH
4. Estimation of FSH
5. Estimation of LH
6. Estimation of hCG
7. Estimation of Cortisol
8. Estimation of Progesterone
9. Estimation of Testosterone

TUMOR & CANCER MARKERS:

1. Estimation of Alpha feto proteins (AFP)
2. Estimation of Carcino embryonic antigen (CEA)
3. Estimation of CA- 125
4. Estimation of Prostate specific antigen (PSA)

OTHER ELISA TESTS

1. Test for HIV
2. Test for Hepatitis B (HBsAg)
3. Test for Hepatitis (HCV)
4. Malaria antigen
5. Tuberculosis-IgG/IgM

CLINICAL BIOCHEMISTRY

Subject Code : MLT-203

Min. Hrs. - Theory : 100 Hrs. & Practical : 100 Hrs.

THEORY

- 1- Photometry-

Definition, laws of photometry, absorbance, transmittance, absorption maxima, instruments, parts of photometer, types of photometry–colorimetry, spectrophotometry, flame photometry, fluorometry, choice of appropriate filter, measurements of solution, calculation of formula, applications.

- 2- Water & Mineral Metabolism-
Distribution of fluids in the body, ECF & ICF, water metabolism, dehydration, mineral metabolism, macronutrients (principal mineral elements) & trace elements.
- 3- Liver Functions & their Assessment-
Based on: 1- Carbohydrate metabolism 2-Protein metabolism 3- Lipid metabolism
4-Measurements of serum enzyme levels 4-Bile pigment metabolism, Jaundice, its types and their biochemical findings.
- 4- Renal Function Tests-
Various Tests, GFR & Clearance
- 5- Immunodiffusion Techniques, Radioimmunoassay & ELISA-
Principles & Applications.
- 6- Electrophoresis -
Principle, Types & Applications.
- 7- Polymerase Chain Reaction -
Principle & Applications
- 8- Autoanalysers -
Principle & Applications
- 9- Vitamins-
Fat & water soluble vitamins, sources, requirement, deficiency disorders & biochemical functions.
- 10- Cardiac Profile -
In brief Hypertension, Angina, Myocardial Infarction, Pattern of Cardiac Enzymes in heart diseases
- 11- Different methods of Glucose Estimation-
Principle advantage and disadvantage of different methods
- 12- Different methods of Cholesterol Estimation-
Principle, advantage and disadvantage of different methods.

PRACTICAL **(By Colorimeter / Spectrophotometer)**

1. Blood urea estimation
2. Serum creatinine estimation
3. Serum uric acid estimation
4. Serum total protein estimation
5. Serum albumin estimation
6. Serum globulin estimation
7. Serum glucose estimation
8. Total cholesterol estimation
9. HDL cholesterol (direct) estimation.
10. LDL cholesterol (direct) estimation
11. Triglyceride estimation
12. Serum Bilirubin total estimation
13. Serum Bilirubin direct estimation
14. Serum amylase estimation
15. Serum GOT (AST) estimation
16. Serum GPT (ALT) estimation
17. Alkaline phosphatase estimation

18. Acid phosphatase estimation
19. Serum sodium estimation
20. Serum potassium estimation
21. Serum chloride estimation
22. CK-NAC estimation

IMMUNOLOGY, SEROLOGY & PARASITOLOGY

Subject Code : MLT-204

Min. Hrs. - Theory : 100 Hrs. & Practical : 100 Hrs.

THEORY

IMMUNOLOGY & SEROLOGY

1. Immunity
 - Definition and classification
 - General Principles of Innate & Acquired Immunity.
2. Immune Response
 - Humoral immunity & cell mediated immunity.
3. Antigen
 - Definition, classes, properties.
4. Antibodies/Immunoglobulins - Definition, Properties, Sub types of Immunoglobulines
5. Antigen/Ab Reaction/Serological Refractions -
6. Features of antigen/antibody Reaction-
 - Precipitation
 - Agglutination
 - Complement fixation test
 - Neutralization
 - Opsonization
 - Immune adherence
 - Immuno fluorescence
 - Immuno electron microscopic test
7. Structure and functions of Immune System
 - Parts of Immune system
 - T/B cells, other cells & their functions
8. Hyper sensitivity Reactions
 - General Principles of different types of hypersensitive reactions i.e., type 1, 2, 3, 4.
 - Auto immune disorders
9. ELISA
10. Vaccination
 - Schedule & Vaccines

PARASITOLOGY

1. Definition - parastism, HOST, Vectors etc.
2. Classification of Parasites .
3. Phylum Protozoa- general Pathogenic and non pathogenic protozoa.
4. Phylum Nematelminths/Round words (Nematoda) .
5. Phylum Platyhelminths - class-Cestoda, class-Trematoda.
6. Lab diagnosis of parasitic infections.

Protozoa :

- i. Intestinal Amoebae
 - a. *E. Histolytica* : Life cycle, Morphology, Disease & Lab Diagnosis
 - b. *E. coli* : Life cycle, Morphology, Disease & Lab Diagnosis
- ii. Flagellates of intestine/genitalia
 - a. *Giardia lamblia* : Life cycle, Morphology, Disease & Lab Diagnosis
 - b. *Trichomonas vaginalis* : Life cycle, Morphology, Disease & Lab Diagnosis
- iii. Malarial Parasite
 - a. *Plasmodium vivax* : Life cycle, Morphology, disease & lab diagnosis
 - b. Differences between *P. vivax*, *P. malaria*, *P. falciparum* & *P. ovale*.

Nematodes :

Intestinal Nematodes :

- a. *Ascaris* : Life cycle, Morphology, disease & lab diagnosis
- b. Brief discussion about *Enterobius vermicularis* (Thread worm) and *Ancylostoma duodenale* (Hook worm)

Tissue Nematodes :

- W. Bancrofti* - Life cycle, Morphology, Disease & Lab Diagnosis

Phylum Platyhelminths

- a. Cestodes - *T. solium*, *T. saginata* & *E. granulosus*. (in brief)
- b. Trematodes - *S. haematobium* & *F. hepatica* (in brief)

PRACTICAL**IMMUNOLOGY & SEROLOGY**

- WIDAL Test
- VDRL Test,
- RA Test
- CRP Test
- Pregnancy Test & HIV Test

PARASITOLOGY

- Stool examination.
- Identification of different ova & cysts in stool samples.

B.Sc. in Medical Laboratory Technology (B.Sc.-MLT) Third Year**HISTOPATHOLOGY & CYTOLOGY TECHNIQUES**

Subject Code : MLT- 301

Min. Hrs. - Theory : 80 Hrs. & Practical : 80 Hrs.

THEORY

1. Introduction to Histopathology, exfoliative Cytology.
2. Basic steps for Tissue Processing- Fixing, Embedding, Microtomy, Staining, Mounting, methods of decalcifications.
3. Laboratory requirements for Histopathology & Cytology - Chemicals & Reagents
4. Equipments - Microscope, Microtome -Types, Uses, Parts, different types of microtome knives, care & maintenance. Automated tissue processor - components, working & precautions during use, Tissue floating bath.
5. Staining Methods -

- a. Hematoxylin & Eosin stain, Hematoxylin - Types, methods of preparation, staining, Eosin - Method of preparation.
- b. Reticulin stain
- c. PAP staining- components & methods.
6. Museum Techniques
 - a. The mounting of pathological specimens - Introduction., Preparation of specimen, Fixation of specimen- Kaiserling solution-1 & Kaiserling solution-2
 - b. Precaution taken for the Fixation of Specimens.
 - c. Storage of Specimens.
 - d. Mounting of Museum Specimens.
 - e. Routine Mounting of Specimens.
 - f. Filling and Scaling.

PRACTICAL

1. Parts of microtome
2. Tissue processing
3. H&E staining
4. PAP staining.

COAGULATION STUDIES

Subject Code : MLT- 302

Min. Hrs. - Theory : 80 Hrs. & Practical : 80 Hrs.

THEORY

1. Hemostasis - Definition, Basic concept and principle, Basic steps involved in Hemostasis.
2. Coagulation -
 - a. Basic Physiology, coagulation factors.
 - b. Mechanism of blood coagulation.
 - c. Extrinsic Pathway.
 - d. Intrinsic Pathway.
 - e. Regulators of blood coagulation.
3. Testing of blood coagulation -
 - a. Bleeding Time, Duke's method.
 - b. Clotting Time- Capillary tube method & Lee white's method.
 - c. PT, aPTT, TT
 - d. Clot retraction time
 - e. Determination of fibrinogen.
4. Quality Assurance for routine Hemostasis Laboratory-
 - a. Introduction.
 - b. Sample collection technique (Phelbotomy)
 - c. Sample preparation, Anticoagulant used, Importance of use of Sodium Citrate.
5. Role in Diseases, Bleeding disorders-
 - a. Platelet disorder - Thrombocytopenias - causes including aplastic anemia.
 - b. D I C
 - c. I T P
 - d. Hemophilia

PRACTICAL

1. Precautions to prevent hemolysis
2. Storage of blood specimens
3. Bleeding time & clotting time estimation
4. Prothrombin time estimation
5. aPTT (activated partial thromboplastin time) estimation.
6. Clot retraction time.

SYSTEMIC BACTERIOLOGY, MYCOLOGY & VIROLOGY

Subject Code : MLT- 303

Min. Hrs. - Theory : 120 Hrs. & Practical : 80 Hrs.

THEORY

SYSTEMIC BACTERIOLOGY

Study of -

Staphylococcus, Streptococcus, Pneumococcus, Neisseria gonorrhoea, Neisseria meningitis, Corynebacterium diphtheriae, Mycobacterium, Clostridium, E.coli, Klebsiella, Salmonella, Proteus, Pseudomonas, Vibrio & Spirochaetes with reference to their :

- Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis.

MYCOLOGY

- Morphology and Structure of fungi
- Classification of fungi
- Nutrition and cultivation of fungus
- Cutaneous & Sub cutaneous and Systemic Mycosis (in brief)
- Lab diagnosis of fungal Infections
- Opportunistic fungal infections

VIROLOGY

- General characters of viruses
- Classification of viruses
- Lab diagnosis of viral infections
- Cultivation of viruses
- Bacteriophages.
- Retro viruses - HIV, Hepatitis virus , Pox virus ,
- Picorna virus - Polio
- Orthomyxo virus - Influenza
- Arbo virus - Chikungunya, Dengue
- Herpies and Adeno virus

PRACTICAL

SYSTEMIC BACTERIOLOGY

1. Culture Techniques
2. Composition of culture media
3. Preparation of media
4. Identification of media & their uses
5. Culture methods & identification of common bacteria on media.
6. Antibiotic sensitivity testing.

MYCOLOGY & VIROLOGY

1. Culture Media used for fungus.
2. Fungal culture
3. Methods of lab diagnosis & virus.

QUALITY LABORATORY MANAGEMENT & AUTOMATION

Subject Code : MLT- 304

Min. Hrs. - Theory : 60 Hrs. & Practical : 140 Hrs.

THEORY

AUTOMATION

1. Automation - Introduction, meaning, advantages, history
2. Continuous flow analyzers
3. Single channel continuous flow analyzers-advantages, disadvantages
4. Multi channel flow analyzers
5. Discrete auto analyzers - basic features, types, semi automated, fully automated
6. Batch analyzers
7. Random access analyzers (RAA)
8. Component steps in fully automated analyzers
9. Auto analyzers based on immunoassay techniques, Micro particle enzyme immunoassay (MEIA)
10. Various random access analyzers - Hitachi- 704, BM/Hitachi - 717
11. Centrifugal analyzers, ASCA
12. Dry chemistry analyzers
13. Dimension RxL clinical chemistry system
14. The Heterogeneous Immunoassay module components
15. Beckman Array 360 system
16. Mini Vidas analyzers
17. Immulite automated immunoassay analyzers
18. Latest trends in Automation, Biochips, Lab on a chip (LoC), Nanosensors- advantages and disadvantages, PCR & its applications.

QUALITY LABORATORY MANAGEMENT

1. Introduction to Quality control
2. Total quality management framework

3. Quality laboratory processes, Quality assurance, Quality assessment, Quality control, Quality planning and Quality improvement
4. Costs of conformance and non conformance, appraisal costs, prevention costs
5. Internal quality control, basic steps, sources of error and their correction methods, CAPA - corrective action & preventive action
6. Sources of variation in laboratory results
7. Quality control charts, Levy- Jennings and Cusum charts
8. External quality control
9. Quality control programme, intrinsic and extrinsic and random errors
10. Current trends in laboratory accreditation, ISO certificate, West guard Rules
11. Demonstration of various methods of quality control.

PRACTICAL

CLINICAL BIOCHEMISTRY

(By Semiautoanalyzer / Fully automated analyzer)

1. Estimation of Cholesterol
2. Estimation of HDL Cholesterol
3. Estimation of LDL Cholesterol
4. Estimation of Triglycerides
5. Estimation of LDH
6. Estimation of Glucose
7. Estimation of Bilirubin (Total, Direct, Total + Direct)
8. Estimation of SGPT
9. Estimation of SGOT
10. Estimation of Acid Phosphatase
11. Estimation of Alkaline Phosphatase
12. Estimation of Iron
13. Estimation of Creatinine
14. Estimation of Urea
15. Estimation of Uric acid
16. Estimation of CK-MB
17. Estimation of CK-NAC
18. Estimation of Chlorides
19. Estimation of Sodium
20. Estimation of Potassium
21. Estimation of Hexagon Troponin+
22. Estimation of Phosphorus
23. Estimation of TIBC
24. Estimation of Albumin
25. Estimation of Calcium
26. Estimation of Hemoglobin
27. Estimation of Magnesium
28. Estimation of Blood Urea Nitrogen

ENDOCRINOLOGY, TUMOR AND CANCER MARKERS

(By ELISA Reader)

ENDOCRINOLOGY

1. Estimation of T3
2. Estimation of T4
3. Estimation of TSH
4. Estimation of FSH
5. Estimation of LH
6. Estimation of hCG

7. Estimation of Cortisol
8. Estimation of Progesterone
9. Estimation of Testosterone

TUMOR AND CANCER MARKERS

1. Estimation of Alpha feto proteins (AFP)
2. Estimation of Carcino embryonic antigen (CEA)
3. Estimation of CA -125
4. Estimation of Prostate specific antigen (PSA)

OTHER ELISA TESTS

1. Test for HIV
2. Test for Hepatitis B (HBsAg)
3. Test for Hepatitis (HCV)
4. Malaria antigen
5. Tuberculosis-IgG/IgM