

**"D"**  
**Syllabus**

**Master of Science in Medical Laboratory Technology (M.Sc-MLT)**

**M.Sc.-MLT -First Year**

**Biochemistry, Biomedical Techniques & Laboratory Management**

**Subject Code : MMLT-101**

**Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,**

**THEORY**

**A - BIOCHEMISTRY**

**1. CHEMISTRY OF CARBOHYDRATES**

- Definition and Function
- Classification
- Isomerism of Monosaccharides
- Properties of Monosaccharides
- Modified Monosaccharides
- Disaccharides
- Polysaccharides

**1. CHEMISTRY OF PROTEINS**

- Definition, function of Proteins
- Classification of Amino acids
- Properties of Amino acids
- Classification and properties of proteins
- Structural organization of proteins

**2. CHEMISTRY OF LIPIDS**

- Definition and function of Lipids
- Classification of Lipids
- Properties of Lipids

**3. NUCLEIC ACIDS**

- Nucleotides and its bases
- DNA in detail
- RNA and its classification
- High energy compounds

**4. ENZYMES**

- Classification of Enzymes
- Factors affecting enzyme activity
- Inhibitors
- Specificity
- Enzyme Kinetics
- Enzymes in clinical diagnosis

**5. Clinical significance, principle of estimation**

- Bilirubin General types and Jaundice
- Liver Function Test
  - i) Bilirubin estimation
  - ii) Alkaline phosphates and acid phosphates estimation
  - iii) SGOT, SGPT Estimation
- Glucose tolerance test (GTT) importance and principle and techniques of GTT
- Insulin tolerance test

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- Gastric juice analysis
- Xylose absorption test
- Analysis of calculi
- 6. Cerebrospinal fluid analysis
  - Composition and function of CSF
  - Clinical significance of CSF analysis
  - Estimation of sugar and proteins in CSF
- 7. Urine chemistry
  - Automation in Urine chemistry
  - Physical and Chemical examination of Urine samples. Qualitative tests for inorganic urinary ingredients
  - Common qualitative and quantitative tests of urine
  - Clearance test for urine function
- 8. Blood gases and pH, carboxyhemoglobin, CO, Met Hb, O<sub>2</sub> saturation
- 9. Blood collection procedures- theory of anticoagulation.
- 10. Bio-Medical waste: Types, potential risks and their safe management.

### **B: -BIOMEDICAL TECHNIQUES**

#### 1. Methods of qualitative analysis of biomolecules:

Principles, experimental procedures and application of chromatography – paper, thin-layer, ion exchange, affinity, gel filtration, gas-liquid and HPLC. Principles, procedures and application of Electrophoresis – paper, polyacrylamide gel, agarose gel, capillary and cellulose acetate.

#### 2. Quantitative methods:

Principles and applications of Photometry, Spectrophotometry, fluometry, ion selective procedures, flame photometry, atomic absorption spectrometry. Ion selective electrodes and their applications in Medicine.

#### 3. Centrifugation Techniques –

Principle and technique of preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation, ultra-centrifuge and its application.

#### 4. Radio Isotopes:

Detection and measurement of radioactive isotopes, application of isotopes in research and clinical bio-cemsitry, Radioactive emissions, radiation-matter interaction, radiation dose.

#### 5. Cell Fractionation, Biochemical activities of different fractions, marker enzymes.

#### 6. Bioenergetics and Biological oxidation:

Concept of free energy change, high energy compounds, ATP generation, redox Potential Assessment, Electron transport chain, oxidative phosphorylation, inhibitors, Uncouplers, ionophores.

#### 7. Purification of enzymes from cells, characterization and Internal Assessment of purity, purification of proteins.

### **C. LABORATORY MANAGEMENT**

#### 1. Preparation of operating budgets

General aspects of financial management of laboratories

2. Cost-analysis (tests and instruments); justification of providing new services or rejecting existing ones; lease and purchase decision analysis; delegation of budget responsibilities, work load statistics.

#### 3. Laboratory design

Designing laboratories for different types and sizes of institutions: selection of equipment and systems for the laboratory, concepts of workstation consolidation, workflow analysis, concepts in laboratory automation (sample transportation systems, modular systems, robotics).

#### 4. Laboratory safety

Fire, chemical, radiation and infection control (body substance precautions), hazardous waste and transport of hazardous materials.

#### 5. Training of technical staff

Familiarity is needed with the syllabi of various training programs; knowledge of the teaching requirements and level of knowledge technical staff; understanding of qualifications of technologists trained in other countries.

#### 6. Maintenance of records

Procedure manuals, ward manuals, quality control programs, patient data retrieval.

#### 7. Personnel management

Personnel policy manual; job descriptions; labor, supervision relations; conducting job interviews; motivation, recognizing job distress syndrome; delegation to a laboratory manager.

#### 8. Hospital organization

Interactions between the laboratory service and the rest of the hospital.

#### 9. Professional ethics.

#### 10. Quality assurance;

Total quality management; development and monitoring of performance indicators.

#### 11. Public relations:

hospital and community.

#### 12. Basic clinical epidemiology

#### 13. Laboratory Data Processing

14. General principles of methods for reduction of data into forms suitable for electronic data handling systems (computerized accessioning functions, sample identification and tracking (e.g. bar code systems), result reporting, storage and retrieval, electronic data transfer).

#### 15. Use of computers in quality control and management

Use of computers for calculating analytical results (eg. non-linear functions).

#### 16. General aspects of system design

Central vs. stand-alone systems, host computers and equipment interfaces.

#### 17. Laboratory information systems (LIS), Hospital information systems (HIS).

#### 18. Personal computer use

Word processing, spreadsheets, data-base, graphics, statistics, presentations, email, internet. Security of data storage and transmission.

#### 19. Data base structures and data mining.

#### 20. Appropriate access control to patient information.

## PRACTICAL

### CLINICAL BIOCHEMISTRY

- 1- 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 –abnormal constituents of urine.
- 6- Biochemical examination of CSF.
- 7- Analysis of body fluids.
- 8- Biochemical examination of semen.
- 9- Buffers & Buffering Capacity.
- 10- Estimation of blood sugar by Folin wu method & Glucose Oxidase Method
- 11- Estimation of blood urea.
- 12- Estimation of blood uric acid.
- 13- Estimation of serum creatinine
- 14- Estimation of total serum protein
- 15- Estimation of Inorganic phosphorous
- 16- Estimation of Cholesterol/HDL/LDL Cholesterol by enzymatic method.
- 17- Estimation of Serum Triglyceride
- 18- Estimation of Serum Calcium
- 19- Estimation of Serum Bilirubin- total & direct

- 20- Estimation of Alkaline & Acid Phosphatase
- 21- Estimation of SGOT, SGPT, GGTP
- 22- Estimation of LDH
- 23- Estimation of serum – total protein
- 24- Estimation of serum Globulin
- 25- Estimation of serum – Albumin
- 26- Estimation of CK Nac
- 27- Estimation of CK MB
- 28- Estimation of Sodium
- 29- Estimation of Potassium
- 30- Estimation of Phosphorus
- 31- Estimation of TIBC
- 32- Estimation of Hemoglobin
- 33- Estimation of Serum Amylase
- 34- Estimation of common parameters in urine through use of strips.

#### **BIOMEDICAL TECHNIQUES**

- 1. Chromatography: paper, thin layer, gel, ion-exchange, demonstration of HPLC and GLC
- 2. Photometry, spectrophotometry, atomic absorption spectrophotometry
- 3. Electrophoresis: slide gel, PAGE, Agarose gel, Native, SDS PAGE of Blood Sample. (Demo only)
- 4. Cell fractionation – methods

#### **LABORATORY MANAGEMENT**

Demonstration of various methods of quality control

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# Master of Science in Medical Laboratory Technology (M.Sc-MLT)

## M.Sc.-MLT -First Year

### Clinical Pathology, Hematology & Immunopathology

Subject Code : MMLT-102

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,

### THEORY

#### A. CLINICAL PATHOLOGY

1. Collection, transport, preservation and processing of various clinical specimens
2. Urine examination, Physical, chemical and microscopic.
3. Test for haemosiderin pigment.
4. Renal function tests.
5. Stool examination
  - collection of specimen of faeces
  - Macroscopic (Naked eye) inspection
  - Concentration method, Flotation method.
  - Microscopic examination
  - Chemical examination
  - Strip method
  - Test for Occult blood – Benzidine Test
6. Sputum examination –
  - collection of specimen
  - Physical examination
  - Microscopic – Gram's stain, Ziehl Neelsen stain for AFB
  - Chemical examination
7. Gastric analysis  
Indications, contra indications. Method of collection. Fasting gastric juice – Macroscopic and microscopic examination.
  - Fractional test meal
  - Augmented Histamin test
  - Hollander's test
8. Cerebrospinal fluid analysis  
Method of obtaining CSF, indications, contra indications.  
Examination of CSF :
  - Physical examination
  - Biochemical examination
  - Microscopic examination
    - a. Cytological examination
    - b. Bacteriological examination
9. Body fluids  
Microscopic examination of Pleural, Pericardial, synovial, ascitic and peritoneal fluid.
10. Pregnancy Test- Method, interpretation.

#### B. HEMATOLOGY

1. Haemotopoiesis – Origin, development, function and fate of blood cells.
2. Erythropoiesis – Origin, development of RBCs, biosynthesis of Hb, control of Erythropoiesis.
3. Disorders of Red blood cells, Erythrocyte Indices, Red cell inclusion bodies
4. Anaemia-  
Definition, Pathophysiology, classification -morphologic and Etiologic classification and clinical features. Investigations in a case of anaemia.  
Morphologic – Microcytic hypochromic anaemia, macrocytic anaemia.  
Haemolytic anaemias – Definition, classification, clinical features.

- Investigations to establish a case of hemolytic anaemia.  
 Tests done -
- i. Peripheral smear – specific morphologic abnormalities
  - ii. Reticulocyte count  
 Corrected reticulocyte count  
 Reticulocyte production index
  - iii. Osmotic fragility test
  - iv. Coomb's test
  - v Sickling phenomenon
  - vi. Kleihauer acid Elution test
  - vii. Alkali denaturation test
  - viii Ham's test, Sucrose lysis Test
  - ix Electrophoresis – HbF & Hb A<sub>2</sub> estimation
  - x. Test for G6PD deficiency
- Aplastic anemia. Pancytopenia, Anemia due to abnormal globin synthesis  
 Polycythaemia.
4. Disorders of white Blood cells – Leucocytosis, Leukopenia, Leukaemoid reaction, Myelodysplastic syndrome(MDS) .  
 Leukaemias –Definition, Etiology, Clinical features.  
 Classification- [ French American British- FAB classification], Lab Investigations  
 Cytochemistry of Acute leukaemias  
 Chronic myeloid leukaemia -clinical presentation. Investigations. Philadelphia chromosome.  
 Leucocyte Alkaline Phosphatase [LAP score.]  
 Chronic lymphocytic leukaemia
  5. Plasma cell disorders – classification  
 Plasma cell myeloma – definition,clinical features, investigations.
  6. Myelo Proliferative disorders – general features, classification – investigations  
 Lympho Proliferative disorders - general features, classification, Investigations
  - 7.
  8. Lipid Storage Disorders
  9. Haemoparasites
  10. Bone marrow examination
  11. Haemorrhagic disorders  
 Definition – Pathogenesis, Clinical feature, Classification. - vascular disorders, Platelet disorders, coagulation disorders, Fibrinolysis.  
 Normal haemostasis  
 Investigation of haemorrhagic disorders  
 Tests of vascular and Platelet function – Bleeding time, Clot retraction, Platelet count  
 B.M Aspiration, Platelet Aggregation Studies.  
 Tests for Coagulation Disorders  
 Screening test – First line tests  
 Prothrombin time (PT), Activated Partial Thromboplastin Time(APTT), Thrombin Time (TT)  
 Second line tests – Mixing experiments. Urea Solubility Test [Test for Factor XIII ]  
 Coagulation Factor assay. Factor VIII: C Inhibitor Study.  
 Disseminated Intravascular Coagulation [ DIC ]-Definition, Pathophysiology, Clinical Features and Laboratory Investigations.  
 Fibrinogen assay
  12. Thrombotic disorders –Classification, Pathogenesis, Clinical Features and Laboratory Investigations. Antiphospholipid, Antibody Syndrome.
  13. Automation in Haematology

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## C. IMMUNOPATHOLOGY

1. Mechanism of Ab-mediated inactivation: direct and indirect  
e.g. Diabetes mellitus, Thyroid diseases, Pernicious anemia, Polyendocrinopathy, Infertility, Haemophilia, Myasthenia gravis, Anti-idiotypes and diseases.
2. Immune deficiency disorders
3. Immunohaematologic diseases: Transfusion reactions, erythroblastosis foetalis, warm-antibody diseases, cold antibody diseases, drug and hemolytic diseases, agranulocytosis, thrombocytopenic purpura, immune suppression cytotoxic antibodies in vitro.
4. Immune complex reactions: arthus reaction, serum sickness, evaluation of circulating immune complexes.
5. Connective tissue diseases: Arteritis, SLE, Dermatomyositis, Rheumatic fever, Rheumatoid arthritis, Progressive systemic sclerosis.
6. Atopic anaphylactic reactions: reaginic antibody, anaphylaxis, atopic allergy – factors involved, asthma, hay fever, food allergy, insect allergy, atopic eczema, delayed hypersensitivity reactions, contact dermatitis, viral infections, graft-host relationship in pregnancy.
7. Autoallergic diseases: encephalomyelitis, multiple sclerosis, orchitis, thyroiditis, sjogren's syndrome.
8. Granulomatous reactions: Infectious diseases like Tuberculosis, Leprosy.
9. Autoimmune diseases-organ specific and systemic.
10. Immunomodulators
11. Clinical transplantation-Kidney, Bone marrow, Heart.
12. Immunology of AIDS, Tumour and Tumour markers.
13. Immunohaematology- Compatibility testing.

## PRACTICAL

### A. CLINICAL PATHOLOGY

1. Urine examination - microscopic.  
Urine Test for haemosiderin pigment.
2. Stool examination –
  - i. Macroscopic examination
  - ii. Concentration method, Flotation method.
  - iii. Microscopic examination
  - iv. Benzidine Test- for occult blood
3. Sputum examination - Macroscopic, Microscopic and AFB Staining
4. Examination of Cerebrospinal fluid [CSF] and body fluids.
5. Pregnancy Test
6. Examination of Semen-Microscopic.



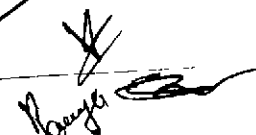
### B. HEMATOLOGY

1. Blood collection. Anticoagulants used in Hematology
2. Red cell indices
3. E.S.R., PCV, Platelet count, Absolute Eosinophil count
4. Reticulocyte count
5. Stains used in Hematology
  - i. Preparation of blood film
  - ii. Preparation of Leishman's stain, Giemsa stain and MGG stain
6. Peripheral smear staining by Leishman's stain. Interpretation of peripheral smear. Differential count.
7. Microcytic hypochromic anemia –  
Investigations including serum Iron & TIBC
8. Macrocytic anemia- Investigations including B<sub>12</sub> & folate assay, schilling test
9. Hemolytic anemia- General Lab investigations

10. Hemolytic anemia- Special Tests.
  - i. Osmotic fragility test
  - ii. Alkali denaturation test
  - iii. Sickling test
  - iv. Hb electrophoresis
  - v. Investigations of G6PD deficiency
  - vi. Autoimmune hemolytic anemia investigations
  - vii. Coomb's test
11. Blood Parasites
12. Bone marrow – preparation of bone marrow smears, Trepine biopsy smears  
Staining of B.M Aspiration Smears. Demonstration of Iron stain
13. Leukemia - Interpretation of Peripheral smear in Leukemia.  
Cytochemical stains – Demonstration
14. Haemorrhagic disorders
  - i. Collection and anticoagulants used – Demonstration
  - ii. BT, CT – Demonstration
  - iii. PT, INR, APTT, TT- Demonstration
  - iv. Mixing experiments – Demonstration
  - v. Test for D-Dimers- Demonstration
  - vi. Assay of coagulation factors - Demonstration
  - vii. Factor VIII: C Inhibitor Study – Demonstration
  - viii. Urea Solubility Test for Factor XIII- Demonstration
  - ix. Fibrinogen assay - - Demonstration
15. Thrombotic work up - Demonstration  
Investigation for Antiphospholipid Antibody- Demonstration
16. Automation in hematology - demonstration
17. Cleaning of glassware
18. Preparation of Stains, Reagents, Diluting fluids.

### C. IMMUNOPATHOLOGY

1. Serological tests (Screening & diagnostic) used in different pathological conditions.
2. Delayed type hypersensitivity testing.
3. Detection of tumor & cancer markers.
4. Histocompatibility testing.
5. Blood grouping & cross matching.
6. Coomb's Test - Direct & Indirect.
7. Setting up of Immuno histochemistry lab.



# Master of Science in Medical Laboratory Technology (M.Sc-MLT)

## M.Sc.-MLT -First Year

### General Microbiology, Immunology and Immunological Techniques

Subject Code : MMLT-103

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,

## THEORY

### A. GENERAL MICROBIOLOGY

#### 1. General aspects.

The investigation of biological samples in infectious diseases is different from the other branches in that it requires general knowledge of pathogenic agents (bacteria or viruses) and of host reaction.

- Definition of infection and infectious disease: natural bacteriological ecosystem.
- Pathogenicity of bacteria and viruses.
- General epidemiology of infection and infectious diseases.
- Sterilization & Disinfection
- Culture media and its preparation
- Bacteriology of Milk, Water and Air

#### 2. Diagnostic procedures.

- Specimen selection and collection (blood, urine, sputum, faeces, others).
- Specimen processing: smears, staining, cultures including cell cultures, susceptibility testing, antigen detection.
- Preservation of cultures
- Usual techniques for microbe and virus identification (including principal differential characteristics).
- Molecular biology techniques for characterization of microbes and viral agents.
- Bacteriological and viral serology.

#### 3. Bacterial and viruses.

Brief description of responsible bacteria and viruses in bacteriological and viral syndromes or diseases (including principal differential characteristics).

- Bacterial: *Neisseria gonorrhoeae* and *N. meningitidis*, *Staphylococcus aureus*, Coagulase Negative Staphylococcus, *Streptococcus pyogenes* (especially *S. agalactiae* and *S. pneumoniae*), *Escherichia coli*, *Salmonella*, *Shigella* and other Enterobacteriaceae,
- *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, *Clostridium perfringens*, *C. tetani*, *Bacteroides* spp, *Lister monocytogenes*, *Legionella*, *Mycobacterium tuberculosis* and others, *Treponema pallidum*, *Chlamydia*, *Mycoplasma*, etc. *Corynebacterium diphtheriae*, *Bacillus anthracis*, *B. cereus*, Non sporing Anaerobes, *Bordetella*, *Brucella*, *Yersinia*, *Actinomyces*, *Pasteurella*, *Francisella*,
- Viruses: herpes (herpes simplex, herpes varicellae, cytomegalovirus, Epstein Barr virus); hepatitis A, B, C, D, E; human immunodeficiency virus; enteroviruses (poliovirus); rubella, mumps, measles, parvovirus B19, RSV, myxovirus, rhinovirus, coronavirus, adenovirus, rotavirus, papillomavirus, rabies, Arboviruses, Poxviruses, Oncogenic Viruses, etc.

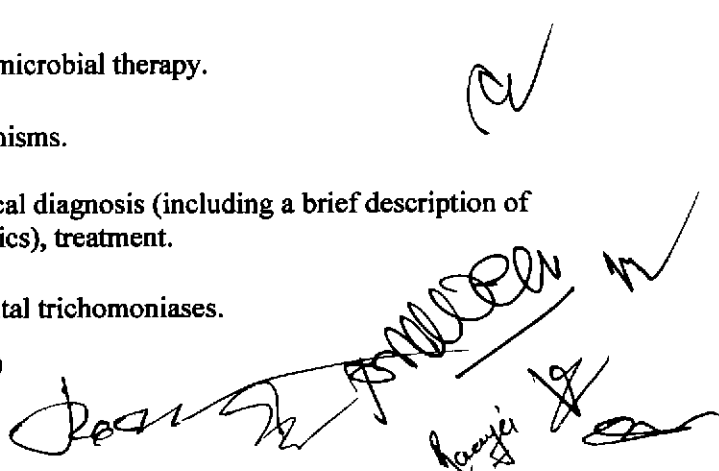
#### 4. Antibiotics and antiviral agents

- Basic knowledge of antibiotics and antimicrobial therapy.
- Antibiotic and antiviral sensitivity test.
- Antibiotic and antiviral resistant mechanisms.

#### 5. Medical Parasitology & Mycology

Epidemiology, main clinical signs, basis for biological diagnosis (including a brief description of parasites and fungi without biochemical characteristics), treatment.

- Amoebiasis: *Entamoeba histolytica*.
- Giardiasis, cryptosporidiosis and uro-genital trichomoniasis.



- Malaria.
  - Toxoplasmosis.
  - Intestinal, hepatic and urinary helminthiasis: strongyloidiasis, ancylostomiasis, enterobiasis, ascariasis, schistosomiasis (*Schistosoma mansoni* and *S haematobium*), fascioliasis (*Fasciola hepatica*) and taeniasis (*Taenia saginata*).
  - Fungal infections (*Candida albicans*, *Cryptococcus neoformans*, etc.).
  - Aspergillus infections (*Aspergillus fumigatus*).
  - Dermatophyte infections (*Microsporum canis*, *Epidermophyton floccosum*, *Trichophyton rubrum*, *Trichophyton mentagrophytes*).
  - Leishmaniasis.
  - Echinococcosis.
  - Pneumocystosis.
  - Filariasis.
  - Leptospirosis
6. Usual techniques for parasite and fungus identification.
7. Immunological and molecular diagnosis of parasitic and mycological diseases.

## B. IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

### Characteristics of the Immune System

1. Define CD antigens.
2. Define primary and secondary lymphoid tissues.
3. Define mucosal-associated lymphoid tissues.
  - oral
  - nasopharyngeal
  - gut-associated
  - reproductive
4. Describe blood-lymph circulation and lymphatics.
5. Organization of lymph nodes
  - Explain hematopoietic cell distribution in lymph nodes.
  - Provide examples and locations of lymph nodes in head and neck.

### Innate and Adaptive Immunity

- Concepts of specificity and memory.
- Basic properties of innate immune cells.
- Basic properties of adaptive immune cells.

### Physiochemical properties of innate immunity

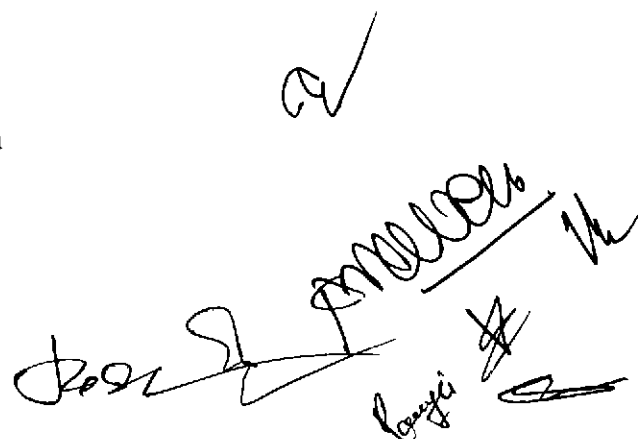
- Physiological barriers
- Anatomical barriers
- Phagocytic/endocytic barriers
- Inflammatory barriers

### Adaptive Immunity

- Humoral immunity.
- Cell-mediated immunity.
- T cells, T cell subsets, B cells, and plasma cells.

### Antigens and Immunogens

- Antigen and immunogen.
- Relative antigenicity of macromolecules.
- Antigenic determinants and epitopes.
- Types of antigens with examples.
- 'Hapten' and its function in the immune system



### Immunoglobulins (Igs)/Antibodies (Abs):

1. Source from B cells and plasma cells
2. B cell/antibody/specificity relationship
3. Structure of immunoglobulins:
  - Molecular components of Igs
  - Heavy and light chains
  - Variable and constant regions
  - Define allotype, isotype, idiotype.

### Classification of immunoglobulins

1. Differences based on heavy and light chains.
2. Functional properties of Ig classes.
3. Evidence for number of antigenic determinants recognized by Igs.

### T cells

1. Classification of T cells (Th1, Th2,  $\alpha\beta$  and  $\gamma\delta$  T cells).
2. Molecular and cellular features of T cell receptor (TCR) to B cells receptor (Ig molecule).
3. Development of T cells in the thymus.
4. The genes' rearrangement in TCR development.
5. T cell-associated molecule - the TCR complex
  - CD3 molecules
  - T cell signaling by CD3
6. Define  $\alpha\beta$  and  $\gamma\delta$  T cells, including
  - Tissue distribution
  - Differential functions of  $\alpha\beta$  and  $\gamma\delta$  T cell.

### The Complement System

1. Complement system and how it is used.
2. Step-by-step examples of how complement works:
  - The classical complement pathway
  - The alternate complement pathway
3. Representative infectious agents and products that activate complement.
4. Biological effects mediated by complement.
5. The effects of complement on the immune system.
6. The significance of complement at oral mucosal surfaces.

### Antigen Processing and Presentation

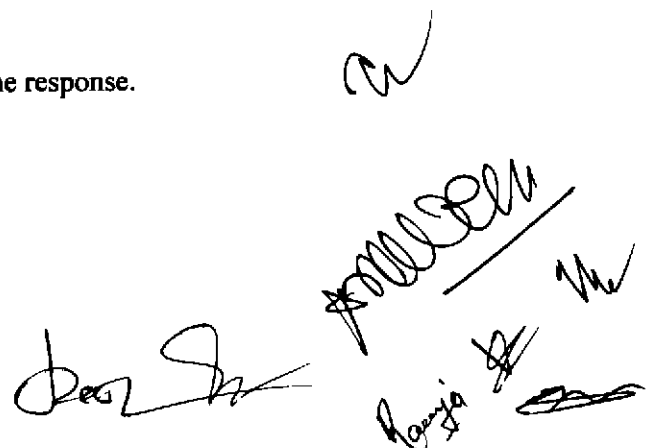
1. Use as a function of T cell activation.
2. Cells involved in antigen processing and presentation.

### The Major Histocompatibility Complex (MHC)

1. Gene nomenclature for MHC antigens.
2. Numbers of human MHC genes.
3. The tissue distribution of MHC antigens.
4. The structure of MHC Class-I and Class-II molecules.
5. Processing of Peptide Antigens

### Cell-Mediated Immunity (CMI)

1. Cells involved in CMI and the role played in the immune response.
2. The mechanisms of tissue cell destruction by T cells.
3. Concept of 'Memory T Cell'.
4. Natural Killer (NK) cell.
5. 'Super Antigen' and give examples in disease.



## PRACTICAL

### A. GENERAL MICROBIOLOGY

1. Collection of clinical materials like blood, urine, stool, sputum, swabs, CSF etc.
2. Parasitology - collection, preservation and transportation of faecal material for examination of parasites. Concentration techniques of stool for ova and cyst. Wet preparation of faecal sample for ova and cyst. Identification of ova and cyst in stool sample.
3. Procedure of techniques of sputum for AFB.
4. Procedure of skin clipping of Leprae Bacilli.
5. Identification of organisms with Biochemical reactions of common organism like - Staphylococcus, E.coli - Klebsiella, shigella, Salmonella, Proteus, Pseudomonas.
6. Antibiotic Sensitivity tests
7. Preservation of stock culture
8. Bacteriology of water
9. Collection of specimen for fungal examination like skin scrapings, swabs, CSF.
10. Fungal examination by wet preparation
11. Fungal culture
12. ELISA HIV & HBsAg test (Demonstration only)
13. Western blot test ( Demonstration Only)
14. Incubation of fertile eggs and inoculation by various routes. (Demonstration only)

### B. IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

1. VDRL Tests
2. Brucella Agglutination test
3. Weil felix test (Demonstration only)
4. Paul Bunnel test (Demonstration only)
5. RA test
6. CRP test
7. TPHA
8. ELISA
9. ASLO
10. WIDAL
11. Pregnancy Test

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**M.Sc.-MLT -First Year**  
**Research Methodology & Biostatistics**  
**Subject Code : MMLT-104**  
**Theory- Min. Hrs -: 100 Hrs.**

**THEORY**

**RESEARCH METHODOLOGY**

**1. Research in Laboratory Technology**

- Introduction
- Research for Laboratory Techniques: Why? How? and When?
- Research - Definition, concept, purpose, approaches
- Internet sites for Laboratory Technician

**2. Research Fundamentals**

- Define measurement
- Measurement framework
- Scales of measurement
- Pilot Study
- Types of variables
- Reliability & Validity
- Drawing Tables, graphs, master chart etc.

**3. Writing a Research Proposal, Critiquing a research article**

- Defining a problem
- Review of Literature
- Formulating a question, Operational Definition
- Inclusion & Exclusion criteria
- Forming groups
- Data collection & analysis
- Results, Interpretation, conclusion, discussion
- Informed Consent
- Limitations

**4. Research Design**

- Principle of Designing
- Design, instrumentation & analysis for qualitative research
- Design, instrumentation & analysis for quantitative research
- Design, instrumentation & analysis for quasi-experimental research
- Design models utilized in Laboratory Technology.

**5. Research Ethics**

- Importance of Ethics in Research
- Main ethical issues in human subjects' research
- Main ethical principles that govern research with human subjects
- Components of an ethically valid informed consent for research

# BIOSTATISTICS

## 1. Biostatistics

- Introduction
- Definition
- Types
- Application in Laboratory Technology

## 2. Data

- Definition
- Types
- Presentation
- Collection methods

## 3. Measures of central value

- Arithmetic mean, median, mode. Relationship between them
- Partitioned values- Quartiles, Deciles, Percentiles
- Graphical determination

## 4. Measures of Dispersion

- Range
- Mean Deviation
- Standard Deviation

## 5. Normal Distribution Curve

- Properties of normal distribution
- Standard normal distribution
- Transformation of normal random variables.
- Inverse transformation
- Normal approximation of Bioaxial distribution.

## 6. Correlation analysis

- Bivariate distribution:
- Scatter Diagram
- Coefficient of correlation
- Calculation & interpretation of correlational coefficient
- T-test, Z-test, P-value

## 7. Regression analysis

- Lines of regression
- Calculation of Regression coefficient
- Sampling distribution
- Standard error
- Types I & II error

## 9. Probability (in Brief)

## 10. Hypothesis Testing

- Null Hypothesis
- Alternative hypothesis
- Acceptance & rejection of null Hypothesis
- Level of significance


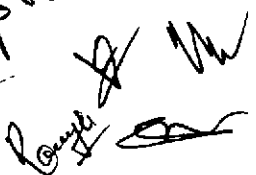
## 11. Parametric & non parametric tests

- Chi square test
- Mann-Whitney U test
- Wilcoxon Signed U test
- Kruskal-Wallis test
- Friedman test
- T-test/student T test
- Analysis of variance

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## 12. Sampling

- Definition
- Types-Simple, Random, Stratified, Cluster & Double Sampling.
- Need for sampling
- Criteria for good samples
- Application of sampling in community
- Procedures of sampling & sampling design errors.

  
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James J. Miller  


**M.Sc.-MLT –First Year**  
**Teaching Skills/Seminars/Symposia/Journal Club etc.**  
**(Common to all specialization/discipline)**  
**Min. Hrs -: 260 Hrs.**

**(a) Teaching Skills**

Candidates should be encouraged to teach undergraduate students if any. This performance will be based on assessment by the faculty members of the department and from feedback from the undergraduate students.

**(b) Seminar**

- Seminars /recent advance presentation will be held every week, however, its timings are subject to clinical schedule. Topics must be well researched and must include common knowledge, recent advances, analysis and references.
- PG students should present minimum of two seminars (One in general and one in elective area) and Internal Assessment marks will depend on better topic selection and presentation.

**(c) Journal Review Meeting (Journal Club):**

The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting.

**(d) Work diary / Log Book**

Every student shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical practice, if any conducted by the candidate by the student.

  
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**M.Sc.-MLT –Second Year**  
**Clinical Biochemistry**  
**Subject Code : MMLT-201B**  
**Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,**

**THEORY**

**1. CARBOHYDRATE METABOLISM AND ITS DISORDERS.**

- Chemistry and Metabolism of carbohydrates.
- Clinical features and laboratory findings in insulin resistance, Type 1, Type 2 and gestational diabetes mellitus; diagnostic and monitoring criteria for diabetes; investigation of hypoglycemic syndromes.
- Glucose tolerance test procedures and interpretation; in pregnancy.
- Ketosis and lactic acidosis.
- Differential diagnosis of coma; hyperosmolar coma.
- Hemoglobin A1c; fructosamines; C-peptide.
- Insulin tolerance test; glucagon and somatostatin.
- Use and dangers of provocative tests, e.g. tolbutamide and glucagon.
- Assay of insulin, proinsulin and insulin antibodies.
- Albuminuria.
- Antibodies (anti-GAD, Anti-insulin, ect.).

**2. PROTEINS, DISORDERS OF PROTEIN METABOLISM.**

- Chemistry and Metabolism of Proteins and Ammaino acids.
- Clinical features and laboratory findings in disorders of the plasma proteins; acute phase proteins.
- Serum protein and albumin, serum and urine protein electrophoresis.
- Causes of hypoalbuminemia; hypo- and hyperglobulinemias.
- Alpha-1-antitrypsin deficiency.
- Ammaino acidurias, screening test for ammaino acid disorders.
- Methods for protein detection in body fluids.

**3. LIPID METABOLISM AND LIPOPROTEIN DISORDERS.**

- Complete Chemistry and metabolism of lipids.
- Clinical features and laboratory findings in disorders of triglycerides, lipoproteins and cholesterol metabolism.
- Lipoproteins and apolipo proteins metabolism; HDL, LDL, VLDL, apoA, apoB, apoC, apoE and their receptors.
- Fat absorption, transport, storage and metabolism.
- Investigation and principles of treatment of hyperlipidemias.
- Assessment of risk factors for atherosclerosis.
- Lipoprotein, lecithin: cholesterol acyltransferase (LCAT).
- Lipid profile, Separation of lipoproteins

**4. CHEMISTRY AND METABOLISM OF NUCLEIC ACIDS**

- Nucleotides and their bases, DNA, RNA, High energy compounds.
- Major roles of purines and pyrimidines, synthesis of pyrimidines, pyrimidine salvage, catabolism of pyrimidines, synthesis of purines, purine salvage, catabolism of purines, GOUT.

**5. VITAMINS**

- Fat & water soluble vitamins, sources, requirement, deficiency disorders & biochemical functions.

## 6. ENERGY METABOLISM AND NUTRITION

- Food calories, RQ, BMR, calorie requirements, proteins in nutrition, fats in nutrition, carbohydrates in nutrition, fibers in nutrition, protein-energy malnutrition, starvation, diet for normal adults, pregnant women, children, etc.

## 7. MINERAL METABOLISM AND ITS DISORDERS.

- Sodium and potassium, chlorine, calcium and phosphorus, magnesium, sulfur metabolism, Iron, copper, Zinc, Manganese, Molybdenum, Cobalt, Selenium, Iodine, Fluorine, chromium, Water Balance.

## 8. BIOLOGICAL OXIDATION AND ELECTRON TRANSPORT CHAIN (ETC.)

- Oxidoreductases, Redox potential, Mitochondrial respiratory chain, electron shuttles, oxidative Phosphorylation, Uncouplers of oxidative Phosphorylation.

## 9. LIVER AND BILIARY TRACT STATUS

- The dynamics and mechanisms of liver enzyme release and the clinical utility of measuring hepatic enzymes (e.g., aspartate aminotransferase, alanine aminotransferase,  $\gamma$ -glutamyltransferase, alkaline phosphatase, and lactate dehydrogenase).
- The biochemical assessment of liver function by nonenzyme analytes such as albumin, ammonia, bile acids, bilirubin, urea nitrogen, cholesterol, total protein, and triglycerides.
- Bilirubin metabolism, fractionation of bilirubin (conjugated, unconjugated,  $\delta$ -bilirubin, direct vs indirect) and unique aspects of neonatal bilirubin. Understand the conditions and genetic defects that affect bilirubin metabolism, transport and clearance (e.g., Gilbert disease and Dubin-Johnson syndrome).
- Jaundice

## 10. RENAL FUNCTION

- The basic physiology of renal function. The basic categories of renal diseases (e.g., pre renal azotemia, obstructive azotemia, glomerulonephritis, acute vs chronic renal failure, uremic syndrome) and be familiar with the National kidney Foundation practice guidelines for these conditions. The laboratory analytical methods (e.g., Jaffe vs creatinase) for the assessment of renal function (creatinine, urea nitrogen, glomerular filtration rate) and proteinuria. The concept of creatinine clearance, how it can be used to estimate glomerular filtration rate, and the various methods employed to measure it. Renal handling of electrolytes and key metabolites and the interpretation of urinary electrolyte measurements.
- The definition of osmolality, molecules in serum that contribute to osmolality, and calculation of osmolal gap as well as the principle of the osmometer. The common pitfalls and sources of error during estimation of the osmolal gap (e.g., hyperproteinemia, hyperlipidemia, hypermagnesemia). The differential diagnosis of an unexplained, increased osmolal gap, including alcohol or glycol ingestion, alcoholic or diabetic ketosis or ketoacidosis, and osmotherapy (e.g., mannitol or glycerol administration), among others. The principles of fluid balance.

## 11. GASTRIC & PANCREATIC FUNCTION

- The clinical manifestations of gastric, pancreatic, and intestinal disease and diagnostic methodologies such as the breath tests for *Helicobacter pylori*, fecal occult blood, lipase and amylase (e.g., fractionation of amylase; pancreatic vs salivary and amylase/creatinine clearance ratio).
- The role of gastrointestinal hormones and enzymes in digestion and the evaluation of malabsorption and diarrheal syndromes.

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## 12. ACID-BASE CHEMISTRY WATER AND ELECTROLYTES BALANCE.

- Define the Henderson-Hasselbach equation. Physiologic buffers systems and the role of respiratory and renal compensation. Categories of clinical disorders of acid-base balance (metabolic and respiratory acidosis, metabolic and respiratory alkalosis, mixed disorders).
- The differential diagnosis of common electrolyte disorders

## 13. ISOENZYMES AND CLINICAL ENZYMOLOGY

## 14. PEDIATRIC CLINICAL BIOCHEMISTRY

- Problems of specimen collection; capillary specimens.
- Reference range differences in infants and children: Those that vary significantly with age and sex (inorganic phosphorus, creatinine, alkaline phosphatase, aspartate aminotransferase, creatine kinase).
- Special problems in pediatrics: Respiratory distress syndrome, gastrointestinal disease (fat absorption, disaccharide intolerance, protein-losing neonatal)
- hyperbilirubinemia; cystic fibrosis; neuroblastoma (VMA, HVA); enteropathy), Heavy metal poisoning in children.

## PRACTICAL

### Clinical Biochemistry Practical

- Anti Coagulants.
- Blood Specimen Collection.
- Protein precipitants.
- Estimation of blood sugar by Folin wu method & Glucose Oxidase Method
- Estimation of blood urea.
- Estimation of blood uric acid.
- Estimation of serum creatinine.
- Estimation of total serum protein.
- Estimation of Inorganic phosphorous.
- Estimation of Cholesterol/HDL/LDL Cholesterol.
- Estimation of Serum Triglyceride
- Estimation of Serum Calcium
- Estimation of Serum Bilirubin- total & direct
- Estimation of Alkaline & Acid Phosphatase
- Estimation of SGOT, SGPT, GGTP
- Estimation of LDH
- Estimation of serum – total protein
- Estimation of serum – Albumin
- Estimation of CK Nac
- Estimation of CK MB
- Estimation of Sodium
- Estimation of Potassium
- Estimation of Phosphorus
- Estimation of Iron Profile
- Estimation of Hemoglobin
- Estimation of Hexagon Troponin +
- Estimation of Magnesium
- Estimation of Blood Urea Nitrogen
- Estimation of Vitamin D
- Estimation of Serum Amylase
- Estimation of Fe binding Capacity
- Estimation of 17-Ketosteroids in urine
- Estimation of Serum chloride,  $\text{HCO}_3^-$ , pH,  $\text{PO}_2$ ,  $\text{PCO}_2$  blood gas analysis

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**M.Sc.-MLT –Second Year**  
**Endocrinology, Tumor Markers & Automation**  
**Subject Code : MMLT-202B**  
**Theory- Min. Hrs - : 160 Hrs., Practical- Min. Hrs - : 160 Hrs.**

**THEORY**

**ENDOCRINOLOGY**

1. Introduction
2. Difference between hormones and enzymes.
3. Classification of hormones.
4. Neurotransmitter families
5. Hormones receptors
6. Regular and general mechanism of hormone, Signal transductions.
7. Regulation and general mechanism of action of hormones.
8. Pituitary gland & hypothalamus and its hormones.
9. Hormones of the Anterior Pituitary- Growth hormone, Prolactin, Gonadotropin, Follicle Stimulating hormone, Leuteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotrophic hormone (ACTH)
10. Hormones of posterior pituitary (neurohypophysis)- Oxytocin, Antidiuretic hormone (ADH)
11. 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)
12. Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addisons disease, Glucocorticoids & functions, Mineralocorticoids & functions, Cortisol & functions, Cushing's syndrome, Conn's syndrome.
13. Adrenal medulla-metabolism of catecholamines
14. Hormones of the gonads -  
Testosterone, Estrogens, Progesterone, their synthesis and functions.  
Human Chorionic Gonadotropin (HCG), hormone, menstrual cycle, Menopause
15. Gastrointestinal hormones.
16. Hormone of pancreas - Insulin- its metabolic effects on carbohydrates, fats & protein, control of insulin secretion, Insulin like growth factor, Glucagon- functions, metabolic effects, blood glucose regulation, Diabetes Mellitus, Somatostatin.
17. Hormone of kidney - Renin

**ASSESSMENT OF THYROID FUNCTION**

- The structure, biosynthesis, secretion, and metabolism of thyroid hormones (thyroxine (T<sub>4</sub>), triiodothyronine(T<sub>3</sub>), and reverse T<sub>3</sub> (rT<sub>3</sub>). Thyroid physiology and control of thyroid function (thyrotropin-releasing hormone (TRH) and thyrotropin (TSH).
- The common causes of hypothyroidism and hyperthyroidism
- The laboratory tests for evaluation of thyroid disorders and be able to interpret these analytes in their clinical context with an appreciation for the euthyroid sick state.
- Current analytical methodologies for thyroid testing (TSH methods : 1<sup>st</sup>-, 2<sup>nd</sup>-, and 3<sup>rd</sup>-generation assays; isotopic and non-isotopic methods; T<sub>4</sub>; free T<sub>3</sub> methods; T<sub>4</sub>-uptake methods; TSH suppression and stimulation tests).

**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-  
Definition, Classification, Biochemistry and distribution of tumor markers both protein and carbohydrate.
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).
9. Oncofetal antigens.
10. Alpha feto protein (AFP)
11. Carcino embryonic antigen (CEA)
12. Squamous cell carcinoma (SCC) antigen.
13. Carbohydrate markers (introduction of each type)  
CA 15-3, CA 125
14. Blood group antigen (introduction of each type)  
CA 19-9, CA 50, CA 72-4, CA 242
15. Bladder cancer markers (introduction) -  
Bladder tumor antigen (BTA)
16. Fibrin- Fibrinogen degradation product (FDP).
17. Nuclear matrix protein (NMP22).
18. Biomarkers still in research (introduction)-  
Telomeres, TRAP assay, hyaluronic acid and Hyaluronidase
19. Limitations of laboratory assessment various tumor markers and the factors affecting the results of different analytical procedure.
20. The conceptual basis of assays used to screen for malignancy include Bayes theorem.
21. Recent developments in identifying proteomic patterns for cancer detection.

#### AUTOMATION AND POINT OF CARE TESTING (POCT)

#### FREE RADICALS AND ANTIOXIDANTS

#### 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.

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## 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)
5. Estimation of CA-15-3

### OTHER ELISA TESTS

1. Test for HIV
2. Test for Hepatitis B (HBsAg)
3. Test for Hepatitis (HCV)
4. Malaria antigen

### M.Sc.-MLT (Clinical Biochemistry)

#### REFERENCE BOOKS:

1. Strayer H. Gerjmetal-W.H. Freeman and company New York.
2. Lehninger's Principles of Biochemistry – Lehninger. A.L., Nelson. D.L., Eral-C.B.S. Publishers and distributors, New Delhi.
3. Harper Illustrated Biochemistry – Murray R.K. Grannar, D.K. Mayes-P.A. Eral, McGrawHill.
4. Medical Biochemistry – N.V. Bhagavan -Academic Press.
5. Text Book of Biochemistry – A.S. Saini, C.B.S Publishers and distributors.
6. Teitz fundamentals of Clinical Chemistry – Burtis. C.A. Ashoowd E. R. – Har Court (India) Ltd.
7. Varley's Practical Clinical Biochemistry – Gowenlock and Bell William Heinemann.
8. Text Book of Biochemistry with Clinical Correlations – Devlin T.M. Wiley Liss, New York.
9. Clinical Physiology of Acid-Base balance and Electrolyte disorders – Rose. B.D – McGraw-Hill International edition New York.
10. Methods in Bio-Statistics for Medical students – Mahajan. B.K. Jaypee brothers Medical Publishers, New Delhi.
11. Manual of Practical Biochemistry for M.B.B.S - S.K.Gupta, Veena Singh Ghalaut- Arya publishing Company, New Delhi.
12. Clinical Chemistry – Theory analysis and Correlation – Kalpan. L.A. and pesse. A.G- C.V. Moslay and Company St. Louis, M.O.
13. Principles of Biochemistry – CBS Publishers – Lehninger, Nelson, Cox.

## M.Sc.-MLT –Second Year

### Hematology & Clinical Pathology

Subject Code : MMLT-201P

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.

### THEORY

#### HEMATOLOGY

1. General aspects:  
Blood cell formation, Sites of haemopoiesis. Development of blood cells. Morphology and Regulation of haemopoiesis.
2. Red cells  
Basic aspects of anaemia, definition, patho physiology, classification and clinical features. Investigation of a case of anaemia in general.
3. Microcytic hypochromic anaemias  
Sideroblastic anemia  
Anaemia of chronic infection  
Thalassaemia.  
Iron deficiency anaemia – Iron metabolism, causes of iron deficiency, clinical features, laboratory investigations.
4. Macrocytic Anaemias  
Megaloblastic  
Non megaloblastic  
Megaloblastic anaemia – Etiology, clinical features, laboratory investigation. Pernicious anaemia.
5. Normocytic normochronic anaemia  
Anaemia in systemic disorders  
Acute blood loss, Renal failure  
Liver disorders etc.
6. Disorders of Haemoglobin  
Structure of Hb and Synthesis  
Normal and Abnormal haemoglobins  
Haemoglobinopathies
7. Haemolytic anaemia  
Definition, pathogenesis, classification, clinical features, Extrinsic factors & Intrinsic factors - investigation  
Laboratory investigations to establish a case of haemolytic anaemia.
  - I. Peripheral smear – specific morphologic abnormalities
  - II. Special tests
    - a) Osmotic fragility test
    - b) Sickling test
    - c) Kleihauer acid elution test
    - d) Alkali denaturation test
    - e) Ham's test,
    - f) Sucrose lysis test
    - g) Coomb's test
    - h) Electrophoresis – HbF, HbA<sub>2</sub> estimation
    - i) Tests for G6PD deficiency
  - III. Hemolytic disease of new born – causes and investigations
8. Aplastic anaemia  
Pancytopenia.
9. Polycythaemia  
Classification Clinical features, laboratory investigation
10. Leucocyte disorders  
Leukaemoid reaction – type of leukaemoid and diagnosis.  
Myelodysplastic syndrome [ MDS ] Definition, clinical features, peripheral smear and Bone marrow findings.  
Leukaemias: Definition, –French- American-British [FAB ] and

- World Health Organization- classification of acute leukaemias  
 Diagnostic criteria , Cytochemical staining and Immunophenotyping  
 Chronic Leukaemias: classification, Diagnostic criteria .
11. Myeloproliferative disorders –  
 Classification ,Clinical features, laboratory investigations.  
 Chronic myeloid leukaemia in detail.
  12. Lymphoproliferative disorders-  
 Chronic lymphocytic leukaemia in detail.
  13. Plasma cell disorders – classification.  
 Plasma cell myeloma – definition. Clinical features, laboratory investigations.
  14. Haemorrhagic disorders:  
 Definition: Pathogenesis, clinical features,  
 Classification: a. Primary hemostasis, b. secondary hemostasis – causes and investigations of both.  
 Fibrinolysis.
  15. Platelet disorders:  
 Quantitative – Thrombocytopenia - Idiopathic thrombocytopenic purpura ( ITP )  
 Classification, clinical features, diagnosis and bone marrow findings in ITP.  
 Qualitative platelet disorders.  
 Thrombocytosis – Definition ,Etiology,. Lab Investigations
  16. Coagulation disorders –  
 Inherited -Haemophilia A and B, von Willebrand’s disease,  
 Acquired: Vit. K deficiency, Liver disease, DIC  
 Tests of vascular and platelet function - Bleeding time, Clot retraction ,Platelet count.  
 Platelet aggregation studies. Bone marrow examination.  
 Tests for coagulation disorders: Screening tests- First line tests -Prothrombin time (PT),  
 Activated partial thromboplastin time(APTT) Thrombin time (TT)  
 Second line tests – Mixing experiments.  
 Coagulation factory assay.  
 Urea solubility tests for Factor XIII.  
 Factor VIII inhibitor study.  
 Fibrinogen assay.  
 Disseminated intravascular coagulation- Definition, Pathogenesis, laboratory investigations
  17. Thrombotic disorders:  
 Classification - Inherited and Acquired.  
 Clinical features, Investigation of thrombotic disorders:  
 Tests: i. Protein C  
       ii Protein S,  
       iii. AT-III  
       iv Factor V leiden  
 Antiphospholipid antibody syndrome: Definition clinical feature laboratory investigation.
  18. B.M.Examination- Aspiration and Trephine biopsy staining
  19. Molecular genetics in hematology

## CLINICAL PATHOLOGY

### Histopathology

1. Introduction to Histopathology, exfoliative Cytology.
2. Basic steps for Tissue Processing- Fixing, Embedding, Microtomy, Staining, Mounting, methods of decalcifications, assessment of decalcification, solution for decalcification.
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.

*Dr. J. Anand*  
*Rajesh*




- 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

### Histopathology

1. Microtome, instrument, principle, use in section cutting, parts and working of commonly used microtome, different kinds of microtome, rotary, base sledge, sliding, low temperature microtome, cryostat, microtome knives, homing and stropping knives.
2. Fixation of tissue, different kind of fixatives, simple fixative, compound fixative, formaldehyde, mercuric chloride, osmium, Picric acid, alcohols, other acids, formalin, buffered formalin, osmic acid, zenleer soln, he; ly's soln, cytological fixatives, nuclear fixatives, fixation of smear etc., decalcification, method of decalcification, assessment of decalcification, soln for decalcification.
3. Processing of tissue, dehydration, impregnation in the wax, manual and automatic tissue processor, gelatin embedding, celloidin embedding, double embedding, cytological fixatives, preparation of different smears, vaginal, sputum, membrane.
4. Section cutting of paraffin sections, section preparation from frozen sections, fixing of tissue to slide, preparation of celloidin section and fixation. Staining techniques, natural dyes, synthetic dyes, basic and acidic dyes, haematoxylin staining, Pap, flicker & Conn, methanamine silver nitrate, ziehl neelsen's stain, propylene glycol sudan technique, papanicolaou, harn's alum, Haematoxylin, acridine orange technique.
5. H&E Staining
6. PAP Staining



**M.Sc.-MLT –Second Year**  
**Blood Transfusion**  
**Subject Code : MMLT-202P**  
**Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 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-antibody reaction.
- 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**

- History of transfusion
- Principal & indications for 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 donor.

- 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.

#### 12. Transfusion Transmitted Infections

#### 13. Haemapheresis

- Definition
- Types of pheresis
- Machines and Techniques.

#### 14. Tissue banking

#### 15. Cord blood banking

#### 16. Stem cell processing, storage and transplantation

#### 17. Disposal of wastes and biologically hazardous substance in the blood bank

#### 18. Medico legal aspects of blood transfusion

#### 19. Technical advances and future trends in blood banking

#### 20. Paternity testing

#### 21. Quality Assurance

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- General condition
- Equipment
- Reagents
- Donor processing

## 22. Drugs control regulation and Blood Bank

### PRACTICAL

- Blood grouping –
  - ABO grouping
  - Forward grouping (slide & tube method)
  - Reverse grouping – preparation of pooled A, B & O cells
  - Grading of Reaction. Other methods of grouping.
  - ABO antibody titration, Cold antibody titration.
- Rh grouping & Rh typing (slide & tube method)
  - Du Testing
  - Rh – antibody titration
- Antiglobulin Testing
  - Direct and Indirect
  - Preparation of Coomb's Control Cells.
- Compatibility Testing
  - Selection of blood
  - Crossmatching Technique – Major, Minor, Saline, Albumin, Coomb's
  - Emergency – Cross matches
- Blood Collection
  - Donor selection
  - Blood collection [Phlebotomy]
  - Post donation Care
- Preservation and Storage of blood
- Preparation and Storage of blood Components
  - Packed Cells, Fresh Frozen plasma [FFP], Platelet Concentrate, Cryoprecipitate
  - Component transfusion -- selection of blood group
- Crossmatching in Special Situations
- Exchange transfusion – selection of blood group
- Autoimmune haemolytic anaemia
- Investigation of Blood Transfusion reaction
- Testing for transfusion Transmitted Diseases
  - Elisa-HIV, HBsAg, HCV
  - VDRL Test
  - Malaria
- Quality control – Methods
  - Reagents
  - Test methods
  - Products
  - Documents
  - Equipment
- Apheresis procedures - Types of pheresis, Machines and Techniques.
- Biomedical Waste management
- Orientation of a blood bank
- Blood Bank Administration
  - Record keeping
  - Computerization in blood transfusion services

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## M.Sc.-MLT (Pathology)

### REFERENCE BOOKS:

#### HEMATOLOGY & CLINICAL PATHOLOGY

1. Clinical Haematology, Illustrated -- Colour Atlas Victor Hoffbrand, John E Peth't.
2. Practical Haematology --Dacie, Lewis.
3. Haematology -- Williams
4. Wintrobe clinical haematology Vol- I.
5. Wintrobe clinical haematology Vol- II.
6. Lynch's Medical Lab -- Technology Latest edition
7. Clinical Diagnosis & Management -- Todd & Sanford.
8. Medical Laboratory Technology by Sood, Jaypee Brothers.
9. Clinical Haematology in Medical Practice -- G.C. Degruchy.

#### HISTOPATHOLOGY

1. Atlas of Histopathology, J.P.
2. Histopathology, Guy Orchard
3. Histopathology, William Stewart.
4. Histotechnology, Freida L. Carson.
5. Forensic Histopathology, Darin P. Trelka.
6. Diagnostic Criteria Handbook in Histopathology, P.J. Tadrous.

#### BLOOD TRANSFUSION

1. Technical manual -- AABB
2. The Clinical use of Blood Handbook, WHO
3. ABO Rh system -- Ortho diagnostics
4. Compatibility testing -- Ortho diagnostics
5. Compendium of transfusion medicine. Fr. R. N. Makroo.
7. Blood transfusion in Clinical Medicine -- Mollison.
8. Blood group Serology, Theory, Techniques, Practical application -- K.E.Boorman , B.E Dodd, P.J. Lincoln. 8. Technical Manual, AABB.
9. Rossi's Principles of Transfusion Medicine, Toby L.Simon ,Walter H Dzik,Edward L. Snuder , Christopher P. Stowell Ronald G. Strauss, Lippincott.

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D. S. MULLER  
Rajesh M

## M.Sc.-MLT –Second Year

Systemic Bacteriology, Applied Microbiology and Immunology

Subject Code : MMLT-201M

Theory- Min. Hrs - : 160 Hrs., Practical- Min. Hrs - : 160 Hrs.

### THEORY

#### SYSTEMATIC BACTERIOLOGY & APPLIED MICROBIOLOGY

1. Normal flora of the human body.
2. Collection transport, processing of specimens of diagnosis of bacterial, viral and fungal infection in the following cases. Respiratory tract infections, gastrointestinal tract infections, genital tract infections, CNS infections wounds and abscesses, Eye, ear and sinus infections, infections of the blood, tissue samples for culture. Biological safety in clinical laboratory, quality control, modern techniques employed in clinical laboratory.
3. Nosocomial infections: Epidemiology, bacterial and viral infections, infections in paediatric patients, surveillance and control programmes, organizations and associations involved, role of microbiology lab in prevention and control, devices associated intravascular infections and its control, device associated intravascular infections and its control, sterilization, disinfections and antisepsis in hospitals.
4. Respiratory tract infections: Upper respiratory tract: aetiology, transmission, pathogenesis, epidemiology and clinical features of following:  
Common cold, Pharyngitis and Tonsillitis, otitis and sinusitis, acute epiglottitis, oral cavity infections, laryngitis, and tracheitis, diphtheria.  
Lower respiratory tract- whooping cough, bronchitis, RSV infections, Bacterial diagnosis of respiratory tract infections.
5. Urinary tract infections and sexually transmitted diseases- Bacterial, viral and fungal infections of the urinary tract, etiology, pathogenesis, transmission, clinical features and diagnosis of syphilis, gonorrhoea, Chlamydial infections, HIV, bacterial, Vaginosis, genital herpes, papiloma virus infections, opportunistic STDs.
6. Gastrointestinal tract infections: etiology, pathogenesis, clinical features, and diagnosis of diarrhoeal diseases (bacterial and viral), H.pylori, food poisoning, parasites in the GI tract, systemic infections from GI tract.
7. Central nervous system infections: meningitis caused by bacteria, viruses, fungi and protozoa, viral encephalitis, brain abscesses, tetanus, botulism.
8. Infections of the skin, ear and eye: Etiology, transmission, diagnosis and prevention.
9. Microbiology of air, water and mild: common pathogens encountered, methods for microbiological analysis, methods for purification.
10. Identification of Non-fermenters- Pseudomonas, Acinetobacter, Stenotrophomonas
11. Commercial kit systems-API, Automated and semi-automated identification systems- BACTEC, Vitek
12. Quick screening methods, Chromogenic agar media
13. Bacteriology of Milk, Water and Air
14. Molecular biology techniques for characterization of microbes and viral agents. Bacteriological and viral serology.
15. Bacteriological and viral syndromes or diseases:  
epidemiology, main clinical signs, basis for biological diagnosis, treatment.
  - Meninged syndrome.
  - Septicaemic syndrome.
  - Urinary and genital infections.
  - Bacteriological and viral diarrhoeas.
  - Respiratory infections.
  - Human acquired immunodeficiency syndrome.
  - Sexually transmitted diseases.
  - Hepatic virus infections.
  - Cytomegalovirus infections

## IMMUNOLOGY

1. History of immunology, innate and acquired immunity, mechanisms of innate immunity inflammation-inflammatory cells, mediators, inflammatory response types, antigens, cells and organs of immune system, evolution of immunity.
2. Immunoglobulin: Structure and function, classes and subclass-Cryoglobins, immunoglobulins genes –Organisation and expression, antibody diversity, class switching, monoclonal antibodies-hybridoma technique and MAB production, application in biomedical research, clinical diagnosis and treatment.
3. Immune Response: Clonal selection theory and related theories, primary and secondary response, humoral and cell mediated response, antigen processing and presentation, role of accessory molecules, MHC-structure and role in antigen presentation, MHC genes, maturation activation and differentiation of B cells and T cells, lymphocyte trafficking, TCR-structure and generation of diversity, cytokine properties and function, cytokine receptor, therapeutic uses, ADCC, NK cell regulation of immune response, advances in the development of vaccines (eg. Haemophilus B conjugate, Pertusis, Cholera, Malaria, Hepatitis B, Polio, HIV, Antitumour) adjuvants.
4. Compliment system: function, compliment receptors, activation pathways, control mechanisms, role in inflammation, kinin cascade, kinnins in disease.
5. Immunity against bacteria: Virus, Fungi and Parasites.
6. Immunological methods in clinical laboratories: Method interpretation and application of the following.
  - a. Double diffusion in agar
  - b. Single radial immuno diffusion
  - c. Electrophoresis and immunoelectrophoresis
  - d. Chromatography
  - e. Ion exchange
  - f. Affinity (gel)
  - g. RIA
  - h. Elisa
  - i. Western blotting
  - j. Detection of immune complexes, nephelometry
  - k. Immunoflouresence
  - l. Agglutination test direct and indirect
  - m. Haemagglutination and haemagglutination inhibition
  - n. Complement assays-CFT
  - o. Hemolytic assays
  - p. Detection of cellular immunity-delayed hypersensitivity skin test
  - q. Assays for lymphocytes-T and B cells
  - r. Flow cytometry
  - s. FACS
  - t. Mixed lymphocyte culture
  - u. NK cells neutrophil function test
  - v. Histocompatibility testing
7. Auto Immunity
8. Transplantation Immunity
9. Tumor Immunity

## PRACTICALS

### SYSTEMATIC BACTERIOLOGY & APPLIED MICROBIOLOGY

1. Study of normal flora of human body.
2. Isolation, characterization and identification of pathogens from various clinical specimens.
3. Study of morphological, culture and biochemical characters of common bacterial pathogens
4. Study of antibiotic sensitivity of common pathogens.
5. Study of microbial flora of air in various localities.
6. Microbial analysis of water.
7. Microbial analysis of milk.
8. Procedure of skin clipping for Leprae bacilli.
9. Preservation of stock culture
10. Bacteriology of food

### IMMUNOLOGY

1. Double diffusion technique
2. Radial immuno diffusion
3. Haemagglutination inhibition test
4. Haemagglutination test
5. Latex agglutination test
6. Complement fixation test
7. Immunoelectrophoresis
8. Countercurrent immunoelectrophoresis
9. FITC conjugation of antibodies
10. Lymphocyte culture
11. Isolation of lymphoid organs in mice
12. RIA demonstration

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**M.Sc.-MLT –Second Year**  
**Virology, Mycology & Parasitology**  
**Subject Code : MMLT-202M**  
**Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.**

**THEORY**

**VIROLOGY**

Study of the biological properties, pathogenecity, epidemiology, isolation and identification from clinical specimens, lab diagnosis, treatment and immunoprophylaxis of following viruses :

Parvoviruses, Adenoviruses, Herpes viruses, Pox viruses, Hepatitis viruses, Picorna viruses, Rota viruses, Orthomyxoviruses, Paramyxoviruses, Rubella virus, Pabies virus, Papova virus, HIV & Oncogenic viruses.

**MYCOLOGY**

Study of the following Fungi: Epidemiology, pathogenesis, laboratory diagnosis, treatment and prophylaxis of the following fungi :

Superficial mycosis Ptyriasis versicolor, Tinea nigra, Tinea piedra, Dermatophytes, Subcutaneous mycosis Mycetoma, Sporotrichosis, Chromoblastomycosis, Rinosporidiosis, Lobomycosis, Systemic mycosis Histoplasmosis, blastomycosis, Coccidiomycosis, paracoccidiomycosis, Oppurtunistic mycosis, Cryptococcosis, paracoccidiomycosis, Oppurtunistic mycosis- Cryptococcosis, Candidiasis, Aspergillosis, Zygomycosis, Keratomycosis and Otomycosis, Allergic fungal diseases, Mycotoxicosis.

**PARASITOLOGY**

Study of morphology, important developmental stages, symptoms, pathogenesis, epidemiology, diagnosis, treatment, prevention of following parasites :

Entamoeba histolytica, Naegleria, Giardia, Trichomonas, Balantidium, Isospora, Crytosporidium, Malarial parasites, Trypanosoma, Leishmania, Toxaplasma gondii, Pneumocystis carinii, Taenia Echinococcus, Schistostoma, Paragonimius, Diphyllbothrium, Ascaris, Enterobius, Ancylostoma, Trichuris trichura, Wuchereria, Dracunculus, Trichinella spiralis.

**PRACTICALS**

- Common diagnostic tests used for detection of viral infections.
- Identification of fungal pathogens in clinical specimens.
- Diagnostic tests for detection of parasitic infections- methods for demonstration of parasites in clinical specimens
- preparation of blood smear for detection of filarial parasites.
- ELISA test HIV & HBsAg.

**M.Sc.-MLT (Medical Microbiology & Immunology)**

**REFERENCE BOOKS:**

1. Text book of Microbiology by Ananthnarayan, Orient Longman.
2. Diagnostic Microbiology by Bailey & Scott, Mosby.  
Medical Microbiology by Greenwood & Slack; Churchill Livinstone.
3. The Short Textbook of Medical Microbiology by Satish Gupte; Jaypee.
4. Text book of Medical Parasitology by Panikar; Jaypee.
5. Colour Atlas and Textbook of Diagnostic Microbiology by Koneman, Williams Wilkins.
6. District Laboratory in Tropical Countries, Monica Cheesbrough, Cambridge.
7. Mackie & Maccarteney Practical Medical Microbiology; Churchill Livingstone.
8. Essential Immunology, Roitts & Delves 10<sup>th</sup> Edition; Blackwel Science.