M. Sc. Medical Laboratory Technology
Microbiology & Immunology Specialization

Semester I

Course Code	Course Title	L	T	P	Credit
MAS-711	Biostatistics	2	0	2	3
PH-703	Research methodology in health	2	0	0	2
MLT-702	Immunology	2	0	2	3
MLT-703	Hematology & Blood transfusion	2	0	2	3
MLT-704	General Pathology & Clinical Pathology	2	0	2	3
MLT-705	General Biochemistry	2	0	2	3
MLT-706	General Microbiology	2	0	2	3
Total Credits					**20**

Semester II

Course Code	Course Title	L	T	P	Credit
MLT-711	Molecular Biology and Applied genetics	3	0	2	4
MLT-713	Immunopathology	3	0	2	4
MLT-715	Biomedical Techniques & Laboratory Management	3	0	2	4
MLT-716	Clinical Microbiology	3	0	0	3
MLT-717	Systematic Bacteriology	3	0	0	3
MLT-718	Systematic Bacteriology - Practical	0	0	4	2
Total Credits					**20**

Semester III

Course Code	Course Title	L	T	P	Credit
MLT 730	Hospital Postings	0	0	10	5
MLT -731	Virology	3	0	0	3
MLT-732	Parasitology	3	0	2	4
MLT-734	Mycology	3	0	2	4
Total Credits					**16**

Semester IV

Course Code	Course Title	L	T	P	Credit
MLT – 899	Project	0	0	30	15

Total Credits-71

SEMESTER I

BIOSTATISTICS

COURSE CODE:MAS-711
CREDITS 3(2-0-2)

1) Introduction to Biostatistics
2) Definition, role of statistics in health science and health care delivery system
3) Sampling Population, sample, sampling, reasons for sampling, probability and non-probability sampling
4) Methods of probability sampling-simple random, stratified, systematic-procedure, merits and demerits. Use of random number table.
5) Organization of data
6) Frequency table, histogram, frequency polygon, frequency curve, bar diagram, pie chart
7) Measures of location Arithmetic mean, median, mode, quartiles and percentiles – definition, computation (for raw data), merits, demerits and applications.
8) Measures of variation:Range, inter –quartile range, variance, standard deviation, coefficient of variation- definition, computation (for raw data), merits, demerits and applications.skewness and kurtosis.
9) Basic probability distributions .
10) Concept of probability distribution. Normal, Poisson and Binomial distributions, and application. Concept of sampling distributions. Standard error and confidence intervals.
11) Tests of significance :
12) Basic of testing of hypothesis – Null and alternate hypothesis, type I and type II errors, level of significance and power of the test , p value.
13) Tests of significance (parametric) – t – test (paired and unpaired), Chi square test and test of proportion.
14) Correlation and Regression :
15) Scatter diagram, concept and properties of correlation coefficient, examples (No computation Simple correlation) Pearson's and spearman's, testing the significance of correlation coefficient. Linear and multiple regression.

STATISTICS PRACTICALS

1. Collection and tabulation of data
2. Graphical representation of data
3. Correlation and regression analysis
4. Student's 't' test
5. Chi-square test
6. ANOVA

RESEARCH METHODOLOGY

COURSE CODE: PH 703
CREDITS 2(2-0-0)

Aim
The aim of this Module is to provide the student with experience of research methods and techniques while working alongside research laboratory staff on a designated research project.

Objectives
By the end of this Study Module students should be able to:
(i) design, carry out, write up and critically appraise a selected research topic;
(ii) demonstrate knowledge of skills in appropriate research laboratory practices;
(iii) carry out a range of laboratory techniques using appropriate methodologies.

Constituency
These module are intended for students who wish to learn research methods and techniques and perhaps do a PhD in the future. Some experience of laboratory practice would help the student to take full advantage of this module, although in most instances students will be fully trained in all necessary techniques.

Conceptual outline
This is a purely practical module designed to introduce students to a variety of research techniques and to give them the opportunity of using these techniques in conducting a novel a research project. Each student will choose an individual research project and will be directly supervised by an expert in the field. This Module will necessitate long working hours in some cases and may involve some students studying at institutions other than the parent Institution.

Teaching strategy
This module is entirely laboratory based, with no formal teaching or lectures. Teaching is on a one-to-one basis with a designated supervisor. Students must be highly motivated and be prepared to work long hours in order to make a success of this module.

Reviewing the literature
Aim
This Study Module aims to describe and illustrate the methods available for identifying and reviewing quantitative and qualitative literature.

Objectives
By the end of the Study Module students should be able to:
(i) carry out an appropriate, rigorous review of the literature; and
(ii) understand the strengths and weaknesses of different methods of identifying, assessing and synthesizing literature.

Conceptual outline
This module will cover all stages in carrying out an appropriate and rigorous review.
1. Planning the review: the role of the literature review and specification of the task

2. Identification of relevant literature, both published and unpublished: developing a search strategy and using bibliographic databases.
3. Appraising the literature: methods for assessing the quality of quantitative and qualitative research.
4. Synthesizing the evidence: integration of the evidence using both quantitative and qualitative methods; principles of meta-analysis.
5. Formulating recommendations and writing the review.

IMMUNOLOGY

COURSE CODE: MLT -702
CREDITS 3(2-0-2)

A.Introduction

1. History of immunology
2. Innate immune system-properties and mechanism, non specific defense system, inflammation.
3. Adaptive immune system-properties and mechanism, cells involved, MHC and its role

B .Cells and organs of the immune system

1. Hematopoeisis
2. Cells of the immune system:Lymphoid cells, mononuclear phagocytes, granulocytic cells
3. Primary lymphoid organ: Thymus , Bone marrow
4. Lymphatic system Describe blood-lymph circulation and lymphatics.
5. Secondary lymphoid organ: Lymph node , Spleen, Mucosal-associated lymphoid tissues(Oral, Nasopharyngeal, Gut-associated ,Reproductive), CALT.

C. B- cell and T- cell responses

1. Antigens: Antigenicity, Factors influencing Immunogenicity, Epitopes, Hapten
2. Immunoglobulins / Antibodies: Structure and function, antibody mediated effector functions, Antibody classes and their biological role, Antigenic determinants on Igs (allotype, isotype, idiotype),
3. Hybridoma technology and Mab and its applications, Antibody diversity.
4. Cytokines

D. T-lymphocyte:

1. Classification (Th1, Th2, αβ and γδ T cells)
2. Markers of T-cell-MHC, CD3, CD4, TCR
3. Compare and contrast molecular and cellular features of T cell receptor (TCR) to B cells receptor (Ig molecule)

E. Development of T cell and B-cell:

1. Generation, Maturation, Activation, Proliferation and Differentiation

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F. Complement system

1. Complement activation

2.Classical complement pathway
3.Alternate complement pathway
4.Infectious agents and products that activate complement.
5 Biological effects mediated by complement.
6 Effects of complement on the immune system.
7. Significance of complement at oral mucosal surfaces.

G. Antigen Processing and Presentation

IMMUNOLOGY PRACTICALS

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

HAEMATOLOGY

COURSE CODE: MLT - 703
CREDITS 3(2-0-2)

1. Haematopoesis – Origin, development, function and fate of blood cells.

2. Erythropoiesis – Origin, development of RBCs, biosynthesis of Hb, control of Erythropoiesis

3. Disorder's 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, classifiction, clinical features.

    - Investigations to establish a case of hemolytic anaemia.

5. Aplastic anemia. Pancytopenia, Anemia due to abnormal globin synthesis.

6. Polycythaemia.

7. 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.
    - Chronic lymphocytic leukaemia

8. Plasma cell disorders – classification
   Plasma cell myeloma – definition , clinical features, investigations.

9. Myelo Proliferative disorders – general features, classification – investigations

10. Lympho Proliferative disorders - general features, classification, Investigations

11. Bone marrow examination

12. Haemorrhagic disorders
    - Definition – Pathogenisis, Clinical fearture, Classification. - Vascular disorders, Platelet disorders, coagulation disorders, Fibrinolysis.
    - Normal haemostasis.
    - Investigation of heamorrhagic disorders
    - Tests of vascular and Platelet function – Bleeding time, Clot retraction, Platelet count
    - B.M. Aspiration, Platelet Aggregation Studies.
    - Tests for Coagulation Disorders

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HAEMATOLOGY PRACTICALS

- Blood collection. Anticoagulants used in Hematology
- Red cell indices
- E.S.R., PCV, Platelet count, Absolute Eosinophil count
- Reticulocyte count
- Stains used in Hematology
- Preparation of blood film
- Preparation of Leishman's stain, Giemsa stain and MGG stain
- Peripheral smear staining by Leishman's stain. Interpretation of peripheral smear. Differential count.
- Microcytic hypochromic anemia –
- Hemolytic anemia – General Lab investigations

- Osmotic fragility test
- Coomb's test
- Leukemia - Interpretation of Peripheral smear in Leukemia.

- Collection and anticoagulants used – Demonstration
- BT, CT – Demonstration
- PT,INR, APTT, TT- Demonstration

- Automation in hematology - demonstration

GENERAL AND CLINICAL PATHOLOGY

COURSE CODE: MLT -704
CREDITS 3(2-0-2)

BASIC GENERAL PATHOLOGY

1. Disorders of circulation
    a. Thrombosis
    b. Embolism
    c. Infarction
    d. Oedema
    e. Congestion

2. Mechanism and changes in inflammation
3. Study of tumors
    a. Characteristics
    b. Classification
    c. Aetiology & Pathogenesis
    d. Mention- Recent concepts
4. Common infection
    a. Common acute bacterial infection
    b. Study of tuberculosis, Leprosy, Syphilis
5. A brief study of biological effects of radiation
6. Degenerative changes
    Fatty change
    Necrosis different types
    Gangrene wet & dry
    Pathogenic calcification

7. Definitions of common medical and surgical diagnostic terms.

CLINICAL PATHOLOGY

1.Collection, transport, preservation and processing of various clinical specimens

2.Urine examination, Physical, chemical and microscopic. Urine analysis by Strip method Test for haemosiderin pigment.

3.Sputum examination –
i. Physical examination (macroscopic)
ii. Microscopic – Gram's stain, Ziehl Neelsen stain for AFB

4.Gastric analysis
Indications, contra indication. Method of collection. Fasting gastric juice – Macroscopic and microscopic examination.
i Fractional test meal
ii. Augumented Histamin test
iii. Hollander's test

5.Cerebrospinal fluid analysis
Examination of CSF: i. Physical examination(color and turbidity)
ii. Microscopic examination(total count ,differential count)

6.Microscopic examination of Pleural, Pericardial, synovial and peritonial fluid.

7.Pregnancy Test- Method ,interpretation advantages disadvantages HCG.

8.Semen analysis, liquefaction, volume,color,reactions,pH,motility,sperm count, morphology of sperm- importance and interpretation.

9.Stool examination –
Macroscopic (Naked eye) inspection
i Concentration method ,Flotation method and sedimentation .
ii. Microscopic examination for paracites
iii.Strip method
iv. Test for Occult blood – Benzidine Test

CLINICAL PATHOLOGY PRACTICALS

1. Urine examination, Physical, chemical and microscopic. Urine examination by Strip method
Urine Test for haemosiderin pigment. [Demonstration]
2. Stool examination – Concentration method

3. Sputum examination - Microscopic and AFB Staining and eosinophils
4. Examination of Cerebrospinal fluid [CSF]
5. Pregnancy Test

6. Examination of Semen

GENERAL BIOCHEMISTRY

COURSE CODE: MLT -705
CREDITS 3(2-0-2)

1. Chemistry and metabolism of Carbohydrates-

-general consideration,

-important function,

-classification,

-properties,

-digestion and absorption,

-metabolic fates

2. Chemistry and metabolism of lipids-

-Definition

-Importance

-Classification

-Properties

-Diajestion and absorption

-General metabolism

-Cholesterol

-lipoproteins

3. Chemistry and metabolism of proteins-

-Definition

-Important properties of proteins and amino acids

-general metabolism of different amino acids

4. Chemistry and metabolism of nucleic acids-

-Definition

-Importance

-metabolism of purine and pymidine

5. Liver function tests-

6. Renal function tests

7. Automation in Clinical Biochemistry.

GENERAL BIOCHEMISTRY PRACTICALS

1. Estimation of blood glucose by Folin method, Ortho toludine method & GOD – POD method.
2. Estimation of protein by Biuret method, Lowry, UV method
3. Estimation of serum creatinine by Jaffe's method
4. Estimation of urea in blood sample by urease
5. Estimation of Total cholesterol by CHOD/POD method
6. Estimation of Triglycerides by GOP/PA method
7. Estimation of HDL Cholesterol by precipitation method
8. Estimation of bilirubin in blood sample by kinetic method

GENERAL MICROBIOLOGY

COURSE CODE: MLT -706
CREDITS 3(2-0-2)

- History of microbiology – classification of microorganism – Prokaryotes and Eukaryotes
- Morphology of bacteria – size, shape and arrangement of bacterial cell – cell wall, cytoplasmic membrane, flagella, fimbriae and pili, cytoplasmic matrix, nucleoid, cytoplasmic inclusions.
- Bacteria – Bacterial growth curve, growth requirements
- Stains –simple stains, negative stain, differential stains and special stains.
- Sterilization and disinfection – Definition, physical agents – (sunlight, Drying, Dry heat, Moist heat, filtration, Radiation, Ultrasonic and sonic vibration)
- Chemical- (Alcohols, Aldehydes, Dyes, Halogens, Phenols, Gases)
- Culture methods (streak culture, Pour plate culture, Stab culture, Anaerobic culture methods), colony count
- Identification of bacteria sero-typing and sub-typing, phage typing.
- Bacterial genetics- methods of gene transfer – Transformation-mechanism, natural and artificial, Transduction-mechanism, generalized and specialized transduction, lysogenic conversion, Conjugation-Properties of F-plasmid, HFr strains, col factor, Mechanism
- Bactec Culture

- Antibacterial antibiotics and their mode of action.
- Normal bacterial flora of human body.
- Automation in microbiology
- Quality control in clinical microbiology laboratory.

GENERAL BACTERIOLOGY PRACTICAL

- Sterilization techniques.
- Staining techniques-Gram stain, Acid fast stain, Albert stain.
- Study of motility of bacteria, Hanging drop preparation.
- Preparation of diffent culture media and Biochemical media.
- Culture techniques
- Isolation of bacteria on Nutrient agar, Blood Agar, Maconky agar
- Biochemical reactions-Sugar fermentation test, Oxidation-Fermentation test, Urease test, Citrate test, TSI, M.R., V.P.
- Antibiotic sensitivity test-MIC, MBC, Agar dilution, Broth dilution, Disc diffusion etc
- Anaerobic culture methods.

SEMESTER II

MOLECULAR BIOLOGY AND APPLIED GENETICS

COURSE CODE- MLT 711
CREDITS 4(3-0-2)

1. DNA – structure, types, coiling and supercoiling, topoisomerases, replication, Satellite DNA. Organization of prokaryotic and eukaryotic genome, Chromosomes- structure, number, sex chromosomes, human karyotype, methods for chromosome analysis – chromosome banding, FISH, CGH, flow ,cytometry, cell cycle, mitosis and meiosis.

2. Transcription and Translation: Factors involved, RNA processing, types of RNA, genetic code, Lac operon, Tryptophan operon, regulation in eukaryotes, gene dosage and gene amplification, generation of antibody diversity.

3 Mutation: spontaneous, induced, point mutation and silent mutation, frame-shift mutation, physical and chemical mutagens, molecular basis, site directed mutagenesis, significance of mutagenesis, DNA repair, isolating mutants, Ames test.

4.Recombinant DNA Technology: necessary elements – enzymes and their properties, DNA ligase, DNA ligase, DNA modifying enzymes, cloning vectors plasmids, cosmids, bacteriophages, shuttle vectors, expression vectors, construction of rDNA and cloning strategies – various methods, genomic libraries (eg. Using phage vectors), cDNA libraries, introduction of rDNA into host-methods, restriction maps and sequencing.

5 Genetics in Medicine: Haemoglobin and haemoglobinopathies, phenylketonuria,alkaptonuria, homocystinuria, Lesch-Nyhan syndrome, genetics of cancer, Down's syndrome, Di-george

syndrome, Klinefelter's syndrome, Turner's syndrome, hermaphroditism, cystic fibrosis, haemophilia, prenatal diagnosis of genetic diseases, application of recombinant DNA technology in medicine – PCR, RFLP, DNA finger printing, therapeutic proteins, transgenic organisms, gene therapy, human genome project.

MOLECULAR BIOLOGY AND APPLIED GENETICS PRACTICALS

Isolation of DNA and RNA from bacterial cells

Estimation of DNA and RNA

Isolation of plasmids from bacterial cells

DNA electrophoresis

Mitotic and meiotic stages

IMMUNOPATHOLOGY

COURSE CODE- MLT 713
CREDITS 3(2-0-2)

1. Mechanism of Ab-mediated inactivation : direct and indirect
   Eg. Diabetes mellitus, thyroid diseases, pernicious anemia, infertility, haemophilia, myasthenia gravis.
2. Immune deficeincy disorders
3. Immunohaematologic diseases: transfusion reactions, erythroblastosis foetails, agranulocytosis, thrombocytopenic purpura, .
4. Immune complex reactions: arthus reaction, serum sickness,.
5. Connective tissue diseases : Arteritis, SLE, rheumatic fever, rhematoid arthritis,
6. Atopic anaphyllactic reactions : reaginic antibody, anaphylaxis, atopic allery – factors involved, asthma, hay fever, food allergy, insect allergy, atopic eczma, delayed hypersensitivity reactions, contact dematitis,
7. Autoallergic diseases: encephalomyelitis, multiple sclerosis, oorchitis, thyroiditis, sjogren's syndrome.
8. Granulomatous reactions : Infectious diseases like tuberculosis, leprosy.
9. Autoimmune diseases-organ specific and systemic.
10. Clinical transplantation-Kidney ,Bone marrow ,Heart.
11. Immunology of AIDS ,Tumour and Tumour markers.
12. Immunohaematology- Campatibility testing.
13. Different types of Ag-Ab reactions, Principle and Application

IMMUNOPATHOLOGY PRACTICALS

1. Serological tests [Screening &diagnostic] used in different pathological conditions.
2. Blood grouping &cross matching.
3. Coomb's Test - Direct & Indirect.

BIOMEDICAL TECHNIQUES AND LABORATORY MANAGEMENT

COURSE CODE- MLT 715
CREDITS 4(3-0-2)

BIOMEDICAL TECHNIQUES

- 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.

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

- Quantitative methods: Principles and applications of Photometry, Spectrophotometry, flame photometry, flow cytometry

- ELISA,RIA Western Blotting ,FACS , Immunoelectrophoresis

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 safety: Fire, chemical, radiation and infection control
(body substance precautions), hazardous waste and transport of hazardous materials.
4. Maintenance of records: Procedure manuals, ward manuals, quality control programs, patient data retrieval.
5. Personnel management: Personnel policy manual; job descriptions; labor, supervision relations; conducting job interviews; motivation, recognizing job distress syndrome; delegation to a laboratory manager.
6. Hospital organization; interactions between the laboratory service and the rest of the hospital.
7. Professional ethics.
10. Quality assurance; total quality management; development and monitoring of performance indicators.

PRACTICALS `

1. Chromatography: paper, thin layer, gel, ion-exchange, demonstration of HPLC and GLC Electrophoresis: slide gel, PAGE, Agarose gel, Native, SDS PAGE of Blood Sample. (Demo only)

Semester III

Hospital Posting

COURSE CODE: MLT -730
CREDITS-5(0-0-10)

VIROLOGY

COURSE CODE: MLT -731
CREDITS-3(3-0-0)

Systematic study of the following viruses: Their biological properties, Pathogenicity, Epidemiology, isolation & Identification from Clinical Specimens, Lab diagnosis, Treatment and Immunoprophylaxis of Parvo viruses, Adenoviruses, Herpes viruses, Pox viruses, Hepatitis viruses, Picorna viruses, Rota viruses, Ortho-myxo viruses, Paramyxoviruses, Rubella viruses, Rabies viruses, Arbo viruses, Papoa viruses, HIV, Oncogenic viruses.

PARASITOLOGY

COURSE CODE: MLT -732
CREDITS- 4(3-0-2)

Study of morphology, important developmental stages, symptoms, pathogenesis, epidemiology, diagnosis, treatment & prevention of the following parasites.

Entamoeba, Naegleria, Giardia, Trichomonas, Balantidium, Isospora, Cryptosporidium, Malarial Parasites, Trypanosoma, Leishmania, Toxoplasma, Pneumocystis carinii, Schistosoma, Paragonimus, Diphyllobothrium, Taenia, Ascaris, Enterobius, Ancylostoma, Trichuris trichra, Wucherera, Dracunculus, Trichinella spiralis.

PARASITOLOGY PRACTICALS

Diagnostic tests for the detection of parasitic infections – Methods for demonstration of parasites in clinical specimens.

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.

MYCOLOGY

COURSE CODE: MLT - 734
CREDITS- 4(3-0-2)

- Introduction to mycology, classification of fungal infections, fungal infections in men.
- Laboratory diagnosis of fungal infections-Specimens collection, transport of specimens, Different methods employed-direct microscopic Examination, Slide culture technique, fungal culture, serology and animal inoculation.
- Superficial Cutaneous Mycoses- Malassezia infections, Taenia nigra, Piedra, Dermatophytosis.
- Subcutaneous mycosis-Mycetoma, Sporortricosis, Chromoblastomycosis, Phaeohypomycosis, Rinosporidiosis, Lobomycosis
- Systemic mycoses-Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidomycosis.
- Opportunistic mycoses- Candidiasis, Cryptococcosis, Penicilliosis, Aspergillosis, Zygomycosis.
- Occulomycosis, Otomycosis, Mycotic poisoning

MYCOLOGY PRACTICALS

1. Collection, Transport and Processing of specimens.
2. Fungal stains, Preparation of stains & Staining Techniques, Special stains.
3. Preparation of various fungal culture medias & Sterilization.
4. Fungal culture, Slide culture technique & Inoculation techniques.
5. Morphologic study of fungi of medically fungi – LPCB mounts, KOH preparation, India ink preparation.
6. Study of colony morphology of different fungus, isolation of medically important fungi, biochemical tests, Special tests - Germ tube test, Hair perforation test, Chlamydospore production test, Phenol oxidase test.

SEMESTER IV

- Project

COURSE CODE: MLT - 899
CREDITS- 15(0-0-15)