



NIMS UNIVERSITY

SYLLABUS

OF

MASTER OF MEDICAL LAB TECHNOLOGY – MMLT

VERSION 1.2

DIRECTORATE OF DISTANCE EDUCATION

Shobha Nagar, Jaipur-Delhi Highway (NH-11C), Jaipur- 303121
Rajasthan, India

MASTER OF MEDICAL LAB TECHNOLOGY – MMLT

Eligibility	:	BMLT/BPT/BOT
Programme Duration	:	2 Years
Programme Objectives	:	<p>The two- year course in Master of Medical Laboratory Technology is designed to enable prospective learners to achieve the following objectives:</p> <ol style="list-style-type: none">1. Promotion of competencies for performing microscopic and bacteriological tests of human blood, tissues and body fluids for diagnostic and research purposes.2. Development of knowledge on innovative practices in medical and health care system.3. Practice and use of various techniques relating to clinical laboratory analyses.4. Maintenance and care of laboratory glass wares and equipments.5. Gain knowledge on indexing, recording and storage of medical records and reports of patients.6. Develop knowledge to be involved in a variety of routine administrative and clinical tasks.
Job Prospects	:	<p>After the completion of MMLT, a challenging career awaits you in hospitals, minor emergency centers, private laboratory, blood donor centers, doctor’s office or clinics. Common job profiles of students after completing MMLT include:</p> <p>Technician in Blood Banks, Hospitals, Nursing Homes and Diagnostic Labs.</p>

YEAR I

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
ANT16101	Human Anatomy & Physiology	70	30	3
BCH16107	Clinical Biochemistry	70	30	3
PAT16101	Clinical Pathology	70	30	3
MBL16103	Clinical Microbiology	70	30	3
MLT16101	Advance Instrumentation & Techniques	70	30	3
MLT16102	Physiology & Nutrition	70	30	3
BOX16101	Biostatistics & Hospital Management	70	30	3
BBN16101	Clinical Haematology	70	30	3
ANT16101P	Human Anatomy & Physiology	35	15	2
BCH16107P	Clinical Biochemistry	35	15	2
PAT16101P	Clinical Pathology	35	15	2
MBL16103P	Clinical Microbiology	35	15	2
			TOTAL	32

YEAR II

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
MLT16201	Lab Management	70	30	3
BBN16201	Blood Banking	70	30	3
MBL16206	Microbiology	70	30	3
MBL16207	Molecular Biology	70	30	3
EZY16201	Enzymology	70	30	3
MBL16208	Diagnostic Microbiology	70	30	3
BBN16201P	Blood Banking	35	15	2
MBL16206P	Microbiology	35	15	2
MBL16207P	Molecular Biology	35	15	2
EZY16201P	Enzymology	35	15	2
DSR16201	Dissertation	200		2
			TOTAL	28

DETAILED SYLLABUS

INSTRUCTIONAL METHOD: Personal contact programmes, Lectures (virtual and in-person), Assignments, Labs and Discussions, Learning projects, Hospital Training Programmes and Dissertation.

YEAR I

HUMAN ANATOMY & PHYSIOLOGY- ANT16101

UNIT	CONTENTS
1.	Body Cell and Tissues: Cell structure, division & function Cell organelles Tissue- Types of tissues and their functions
2.	Skeletal System: Bones—Types, Structure and Growth Division of the Skeleton Appendicular skeleton Axial skeleton Names of Bones and their parts Joints Classification Types of movements with examples
3.	Digestive System: Components of digestive system Alimentary tube Anatomy of organs of Digestive Tube- Mouth Tongue Tooth Salivary Glands Liver Biliary apparatus Pancreas Intestine Absorption of food and its excretion Role of Bile in digestion and excretion Liver function
4.	Respiratory System: Respiratory system Larynx Bronchi Lungs
5.	Cardiovascular System: Anatomy and Physiology of Heart, Arteries and Veins Circulation- Systemic and pulmonary Chambers
6.	Central Nervous System: Brain Spinal Cord
7.	Skins: Structure and Functions

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Text books of Physiology. Author : Guyton (Arthur C). Prism publishers Bangalore.
- B. Human Physiology. Author : Chatterjee (cc). Medical allied agency

CLINICAL BIOCHEMISTRY- BCH16107

UNIT	CONTENTS
1	Bioenergetics: Bioenergetics Entropy and Enthalpy Concept of free energy Thermodynamics 1 st and 2 nd Law.
2	Carbohydrate: Structure, properties, chemical reactions & functions
3	Amino Acids: Essential & Non-Essential amino acids with structure & function
4	Proteins: Primary, Secondary, Tertiary & quaternary
5	Lipids: Structure, Classification & Properties
6.	Enzymes: Classification, Enzyme action & their mechanism Enzyme inhibition, Mode of action for Chymotrypsin & related enzymes
7	Nucleic Acid: Structure of Purine & pyrimidine bases Nucleotide & Nucleosides DNA & RNA: Structure & Properties Vitamins
8	Regulations and precautions regarding transport of biological specimens
9	Biomedical Waste Disposal
10	Electrolytes: pH - pH meter, pH measurement Buffers and biological buffers
11	Radioactivity: Radioisotopes Ionizing radiations Measurement of radioactivity Applications of radioisotopes in clinical biochemistry and research Storage and disposal of radioactive materials. Biomolecules—Characteristics and properties.
12	Proteins: Classification and properties Structure of proteins

	Chemistry of proteins Chemistry of amino acids Sequencing of proteins
13	Bio-membranes: Chemistry of Bio-membranes Structure of Bio-membranes Transport process across bio-membranes
14	Nucleic Acids: Chemistry and properties Purines, Pyrimidines Nucleosides Nucleotides Nucleic acids Nucleoproteins Genes and Chromosomes.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Title Basic Concepts in Biochemistry: A Student's Survival Guide by Hiram Gilbert McGraw Hill Professional, 1999
- B. Textbook of Biochemistry for Medical Students by Vasudevan DM, S Sreekumari JAYPEEDIGITAL

CLINICAL PATHOLOGY - PAT16101

UNIT	CONTENTS
1	Introduction to Histology: The cell and cell division Tissues- Fresh & Fixed tissues Different types of Embedding Viz. Wax, Resin, Cryostat etc. Basic Cytology
2	Fixation of Tissue: Different kind of fixatives Sample fixative Compound fixative Cytological fixatives nuclear fixatives, fixation of smear Decalcification Method of Decalcification Assessment of Decalcification
3	Processing of tissue: Dehydration Impregnation in the wax Manual and automatic tissue processor

	Embedding Gelatin embedding Celloidin embedding, Double embedding Cytological fixatives Preparation of different smears- Vaginal, Sputum, Membrane
4	Microtome: 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.
5	Paraffin Sections: Section preparation from frozen sections Fixing of tissue to slide Preparation of celloidin section and fixation
6	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.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Textbook of Pathology/ Pathology Quick Review and MCQs Harsh Mohan-JP
- B. Robbins Basic Pathology by Vinay Kumar, M.D., Abul K. Abbas, Jon C. Aster-Elsevier Health Sciences, 2012

CLINICAL MICROBIOLOGY - MBL16103

UNIT	CONTENTS
1	Human Body: Normal flora of human body Collection, transport and processing of specimens for diagnosis of bacterial Viral and fungal infections

	Respiratory tract Gastrointestinal tract Genital tract, CNS and abscesses Eye, Ear, Blood, Skin and Sinus Infections.
2	Infections of Urinary Tract and Sexually Transmitted Diseases: Bacterial, Viral and Fungai infections of urinary tract and sexually transmitted diseases. Microbiology of Air, Water, Milk and Mild common pathogens encountered Microbiological analysis and methods for purification of water and air
3	Study of Morphology: Important developmental stages Symptoms Pathogenesis Epidemiology Diagnosis, Treatment and prevention of parasites found in human system Diagnostics tests for detection of parasite infections.
4	Complement System: Antigen processing and presentation Major histocompatibility complex Cell mediated immunity Immunological test commonly employed in medical laboratory and hospitals.
5	Introduction to Bacteriology: History and scope of Microbiology Contribution of Anatomy Von Leeuwenhook, Louis Pasteur, Alexender Fleming in the development of Microbiology Morphology and ultra structure of bacteria Bacterial cell wall of eubacteria and archaeobacteria Cell membranes – Structure, Composition and Properties
6	Bacterial Nutrition: Nutritional groups Common nutritional requirements, Growth of bacteria under extreme conditions Psychrophiles, Thermophiles, Halophiles Acidophiles Bacterial reproduction Binary fission Endospore formation
7	Mycoplasmas: General characteristics Structure Reproduction
8	Cyanobacteria: General characteristics Structure, Reproduction and economic importance
9	Bacterial Growth: Bacterial growth curve Generation time Growth Kinetics – Synchronous, Batch and continuous cultures Measurement of growth Factors affecting growth.
10	Control of Microorganism: Chemical control of microorganism—Heat, Filtration and Radiation Sterilization of Soaps, Detergents and Dyes. Chemical control of microorganisms-

	Halogens, Phenol and Phenolic compounds Heavy metals, Alcohols, Ethylene Oxide Aldehydes and Hydrogen Peroxide
11	Microbial Classification: Basic of microbial classification Classification and salient features of bacteria according to Bergey's manual of determinative bacteriology. Kingdom fungi Structure, reproduction and classification of fungi General characteristics and life cycle- Zygomycetes Ascomycetes Basidiomycetes Deuteromycetes.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Microbiology: An Introduction, 9/E Tortora Publisher Pearson Education India, 2008
- B. Essentials of Medical Microbiology by Bhatia Rajesh, Ichhpujani Rattan Lal- JAYPEEDIGITAL

ADVANCE INSTRUMENTATION & TECHNIQUE- MLT16101

UNIT	CONTENTS
1	Spectroscopy: Interaction of radiation with matter Emission of radiation. Beer-Lambert relationship, Components of a spectrophotometer. UV and vis spectrophotometry Fluorimetric methods Atomic absorption spectroscopy Application of different spectroscopic techniques
2	Chromatography: Principles of absorption and partition Chromatography Absorption Chromatography Liquid Chromatography Gas liquid Chromatography Ion exchange Chromatography Affinity Chromatography and high pressure liquid chromatography Application of chromatographic techniques in biology
3	Dialysis: Dialysis Electrophoresis, Immune electrophoresis, Isoelectric focusing, Isotachopheresis, Capillary electrophoresis Application of electrophoresis in biology

	Blot techniques – southern and northern techniques.
4	Centrifugation: Centrifugation –Preparative and Analytical centrifuge Sedimentation analysis Zonal and equilibrium density gradient Ultracentrifuge Light, phase contract, Fluorescence and Electron microscopy. Flame photometry Analyzers
5	Radioisotopes: Radioisotopes, Nature of radioactivity, Type of radioactivity, Radioactive decay Units of radioactivity Detection and measurement of radioactivity Knowledge of proportional scintillation and gamma counters Autoradiography Biochemical uses of radio isotopes
6	Instrumentation: Separation of DNA by Agarose Gel Electrophoresis Separation of isoenzymes, lipoproteins by PAGE Separation of amino acids by paper chromatography Separation of amino acids & or carbohydrates by TLC Determination of effect of inhibitor on Km & Vmax values Estimation of proteins by Bradford's method Estimation of proteins by Folin-Lowry's method Scanning of absorption spectra of color formed in biochemical assay on single beam spectrophotometer.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. LabVIEW Based Advanced Instrumentation Systems By S. Sumathi, P. Surekha, S. Sumathi-
Springer

PHYSIOLOGY & NUTRITION- MLT16102

UNIT	CONTENTS
1	Digestion Mechanism: Digestion and absorption of Carbohydrates, Proteins, Fats and Nucleic acids. Physiology and biochemistry of respiration. Detoxification mechanisms Body fluids
2	Blood: Blood clotting, Extrinsic and Intrinsic pathways. Anticoagulants.

	<p>Clot refracts. Acid base balance. Muscle contraction and relaxation sliding filament theory. Biochemical changes taking place after death of the animal</p>
3	<p>Minerals: Sources, functions and importance of macro and micro minerals Balanced diets Nutritional disorder Obesity Ketosis Starvation Malnutrition Deficiency diseases</p>
4	<p>Energy Metabolism: Free energy Endergonic and exergonic reaction Caloric value of good stuffs and its calculation Basal metabolism and BMR, Factors influencing BMR Respiratory Quotient (RQ)</p>
5	<p>Genetic Defects in Urate Metabolism: Gout and genetic defects in urate metabolism. Methods employed usually in protein quality evaluation Nutritional experiments commonly done on laboratory animals Recent advance techniques used in human nutrition studies.</p>
6	<p>Detoxication: Mechanisms of detoxication, oxidation, reduction, hydrolysis Conjugation, detoxication of drugs</p>
7	<p>Nutrition: Caloric values of foods BMR, respiratory quotient, energy requirements, Role of carbohydrates, lipids, proteins and amino acids in diet Nitrogen balance Protein energy malnutrition Glycemic index Diet in pregnancy and lactation</p>
8	<p>Anemia</p>
9	<p>Mineral Metabolism: Metabolism of Calcium Metabolism of Phosphorus Metabolism of Magnesium Metabolism of Sodium Metabolism of Potassium, Metabolism of Chloride Metabolism of Sulphur Metabolism of Iron Metabolism of Copper Metabolism of Iodine Metabolism of Manganese Metabolism of Zinc Metabolism of Molybdenum Metabolism of Cobalt Metabolism of Nickel Metabolism of Chromium Metabolism of Fluorine Metabolism of Selenium</p>

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Exercise Physiology: Energy, Nutrition and Human Performance William D. McArdle, Frank I. Katch, Victor L. Katch

BIOSTATISTICS & HOSPITAL MANAGEMENT- BOX16101

UNIT	CONTENTS
1	Introduction and Some Basic Concepts: Sample and population. Statistical definitions. Random sampling. Testing of hypothesis. Statistical tools for collection, presentation and analysis of data relating to causes and incidence of diseases. Measurement of central tendency. Measures of variation. Frequency distribution.
2	Concept of Probability: Laws of Probability. Probability Distribution Binomial, Normal and Chi-square distribution Commonly used procedures and test of significance and estimation Correlation and regression Test of significance namely Z test, T test, Chi square test, F test Analysis of variance.
3	Research Statistics: Research Statistics pertaining to medical laboratory technology Testing the efficacy of manufacturing drugs Medicines and injections for curbing and controlling specific diseases Statistical analysis of instrumental data and comparison of various biological techniques used in hospitals.
4	Health care – an overview: Functions of Hospital administration Modern techniques in Hospital management Challenges and strategies of Hospital management Administrative Functions– Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership. Designing health care organization.
5	Hospital Management: Medical record, House-keeping services. Laboratory performance. Management of biomedical waste. Total patient care – indoor and outdoor. Nursing and ambulance resources. Evaluation of hospital services. Quality assurance. Record reviews and medical audit.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Hospital Administration: A Ready Reference Author: Garala Miral by JAYPEEDIGITAL
- B. Hospital Administration and Management A Comprehensive Guide Author: Gupta Joydeep Das by JAYPEEDIGITAL

CLINICAL HEMATOLOGY- BBN16101

UNIT	CONTENTS
1	Red Blood Cells: Normal morphology count Isolation from whole blood & count Effect on count & morphology of physiochemical parameters & the diseased state Red cell anomalies & their relevance w.r.t. normal & diseased state
2	Blood Transfusion: Pre-requirement & the complication of mis-matched transfusion. Methods of blood matching
3	White Blood Cells & Platelets: Morphology count & methods of isolation Effect on count & morphology of cell by the physiochemical parameters, Diseased State & the relevance of condition of the diseases
4	Anemia: Definition Types of anemia & their classification Physiochemical, characteristic features Etiology of aplastic anemia Clinical features & diagnosis Hemolytic, Megaloblastic
5	Leukaemia: Definition Classification of leukaemia FAB classification Etiology Physiochemical features of different type of leukaemia with reference to clinical states Diagnosis of different types of leukaemias
6	Coagulation: General pathway (intrinsic & extrinsic) Properties (physiochemical) mode of action of coagulation factors Platelet studies, platelet function tests (for different Coagulation factors) Effect of promoters & inhibitors in coagulation Solution Mode of action. Diseases associated with coagulation disorders— etiology & characteristics features
7	Red Cell Mass Studies: Chemical Method & Radioactive Methods Red Cell function studies

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Clinical Hematology by Neal S. Young, Stanton L. Gerson, Katherine A. High

HUMAN ANATOMY & PHYSIOLOGY – ANT16101P

UNIT	CONTENTS
1	Practical I- Haemoglobinometry White Blood Cell count Red Blood Cell count Determination of Blood Groups Leishman's staining and Differential WBC count Determination of packed cell Volume Erythrocyte sedimentation rate [ESR] Calculation of Blood indices Determination of Clotting Time, Bleeding Time

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Practical Human Anatomy and Physiology by S.R.Kale, R.R.Kale, Nirali Publications
 B. Human Physiology. Author : Chaterjee (cc). Medical allied agency

CLINICAL BIOCHEMISTRY – BCH16107P

UNIT	CONTENTS
1	Practical I- Laboratory Safety- Fire, Chemical, Radiation , Handling of biological specimens, Waste Disposal Regulations, Workplace Hazards. Specimen collection, Identification, Transport, Delivery and Preservation. Patient preparation for tests. Anticoagulants and preservatives Regulations and precautions regarding transport of biological specimens Preparation of high quality water pH determination Preparation of buffers and determination of pH Measurement of radioactivity Practicals related to solvent extraction, Partition coefficient, Dialysis, Concentration,
2	Practical II- Desalting and Ultracentrifugation. Calibration of equipments and laboratory wares. Familiarization and usage of Colorimetry, Specterophotometry, Fluorimetry,

	Flame photometry, Atomic absorption spectroscopy, Nephelometry, Osmometry, Chemiluminescence, Ion selective electrodes, Flowcytometry. Chromatography- Paper, Thin layer, Gel filtration, Ion exchange, HPLC, GLC, Separation of various sugars, Amino acids, Lipids, Drugs toxins etc. Urine aminogram. Electrophoresis :- Paper, Agarose gel, Cellulose acetate, PAGE, SDS-PAGE. Separation of serum proteins, Lipoproteins, Haemoglobin, Globin chain and Isoenzymes Tissue homogenization and cell disruption Cell Fractionation Methods Extraction of Glycogen and its estimation Extraction of protein and its estimation Extraction of lipids and estimation of total lipids, glycolipid, phospholipids and cholesterol. Determination of saponification number and iodine number from oils Estimation of lactic acid and pyruvic acid Qualitative analysis of carbohydrate Detection of unknown sugars Qualitative analysis of proteins Isolation of DNA and RNA Estimation of DNA and RNA Agarose gel electrophoresis of DNA
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LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. http://nsdl.niscair.res.in/bitstream/123456789/691/1/ClinicalBiochem_Concepts.pdf
- B. <http://www.sciencedirect.com/science/journal/00099120>

CLINICAL PATHOLOGY– PAT16101P

UNIT	CONTENTS
1	Practical I- Examination of Urine - Routine and Special tests Examination of Stool - Routine and Special tests Banding techniques
2	Practical II- Semen examination - Routine and Special tests Examination of CSF - Routine and Special tests Examination of various body fluids-Pleural Fluid, Pericardial Fluid, Synovial Fluid, Ascetic Fluid Various methods of detecting HCG levels Structure and molecular organization of Chromosomes Identification of human chromosomes
3	Practical III- Examination of Sputum - Routine and Special tests Karyotyping Direct chromosome preparation of Bone Marrow cells Culture techniques

4	Practical IV- Sex Chromatin bodies Autoradiography of human chromosomes Chromosome Identification by Image Analysis and Quantitative Cytochemistry
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LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. The language of pathology: an introduction to medical terminology and the nature of disease by Glyndwr Walters
- B. Mini Atlas Pathology: 2007 By Harsh Mohan-Jaypee Brothers

CLINICAL MICROBIOLOGY – MBL16103P

UNIT	CONTENTS
1	Practical I- Compound Microscope. Demonstration and sterilization of equipments – Hot Air oven, Autoclave, Bacterial filters. Preparation of bacterial smear and staining – Gram’s ,Acid-fast, Staining of bacterial spores ,Flagella, Capsule, Spirochaetes
2	Practical II- Demonstration of commonly used culture media, Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, Mac conkey medium, LJ media, Robertson Cooked meat media, Potassium tellurite media with growth, Mac with LF & NLF, NA with staph Antibiotic susceptibility test Demonstration of common serological tests – Widal, VRDL, ELISA.
3	Practical III- Grams stain Acid Fast staining Stool exam for Helminthic ova Visit to hospital for demonstration of biomedical waste management. Anaerobic culture methods.
4	Practical IV- Preparation of media, Cultivation of bacteria, Biochemical tests for identification of bacteria, Preservation of stock cultures of bacteria.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Practical Microbiology by Vasanthakumari BI Publications Pvt Ltd, 2009
- B. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf

YEAR II

LAB MANAGEMENT- MLT16201

UNIT	CONTENTS
1	Pathological Clinics: Meaning and structure Ethics of the pathological clinics
2	Pathology Laboratory: Laboratory Organization Quality Control
3	Development: Personality development Patient relationship.
4	Reports writing: Principles and structure of Pathology reports writing Ethics in report writing
5	Computer application: Application of Computers in analyses of pathological specimens Application of Computers in recording and report writing
6	Accountancy: Accountancy in clinical pathology
7	Operation ethics: Introduction Operation ethics
8	Social ethics: Introduction techniques Social ethics of pathology
9	Instruments: Proper handling to instruments
10	Laboratory Management and use of Computer in Laboratory: Laboratory safety Personal management, Record keeping, Data analysis Applications of computer in laboratory Workload analysis Finance: Budgeting, operational expenses, cost accounting, justification of budget. Principles, Application and maintenance of Auto analyzers, Blood gas analyzers, Electrolyte analyzer, Chemiluminescence.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

A. Medical Laboratory Management and Supervision, 2nd ed. By Lionel A. Varnadoe, Jr. Ph.D

BLOOD BANKING- BBN16201

UNIT	CONTENTS
1	<p>Laboratory Organization and Pathological Investigation: Reception, Care and handling of patients Labeling and recording of laboratory investigations Cleaning of glassware, pipettes, E.S.R. tubes and counting chambers Preparation of capillary pipette, distilled water, reagents, buffers</p>
2	<p>Blood Samples and Specimens: Collection of blood Preparation of blood smear, Staining of blood and bone marrow smears. Blood donor selection & screening Blood collection and preservation Principle of clearing and preparing transfusion bottle and tubing sets Preparation and composition of anticoagulant – preservative solutions. Transfusion reaction and their investigations</p>
3	<p>Blood: Measurement of hemoglobin Counting of leucocytes, Counting of Erythrocytes Counting of platelets and reticulocytes. Recognition of blood cells in peripheral blood smear Determination of haematocrite and E.S.R. Preparation of haemolysate Determination of alkali resistant hemoglobin Paper electrophoresis of hemoglobin. Test for sickle cell Bleeding time, coagulation time, prothrombin time, and kaolin cephalin clotting time. ABO blood grouping and Rh typing Performance of direct and indirect coombs test, Red cell agglutination test (screening Paul bunnell test). Preparation for the demonstration of L.E. Cell phenomenon.</p>
4	<p>Blood Group System: Blood Group System. Blood Group Incompatibility, ABO, RH & Systems. Cross Matching Test in emergency.</p>
5	<p>Blood Bank Preparation: Blood collection procedure, care & donor selection registration medical history, physical examination. Transport and storage. Screening and selection of donor. Preparation and use of whole blood and blood components washed red cells.</p>
6	<p>Blood Grouping: ABO Testing slides and tube test. Reverse grouping discrepancies, between cell and serum results sources of error. RH grouping test and slide.</p>

	Rapid tube test false positive and false negative results. DU test system and its significance.
7	Cross Matching: Reasons of cross match Saline Albumin Comb's and enzymes in testing
8	Roles formation and methods of checking: Comb's test – Direct and Indirect, principle, explanation of procedure and sources of error, control interpretation and clinical application. Demonstration of comb's test direct and indirect.
9	Labeling of Tubes, methodology legal implication in computable cross: Auto antibodies, plasma expanders, multiple myeloma etc. Affecting a cross match. Difficulties in cross match and methods of investigations.
10	Quality control in blood banks: Specimen collection. Risk assessment for AIDS and serum hepatitis.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Modern Blood Banking & Transfusion Practices by Denise Harmening-F.A. Davis Company; 5 edition (March 14, 2005)

MICROBIOLOGY- MBL16206

UNIT	CONTENTS
1	Immune Response: Immunity-Type (Innate & adaptive immune response) Organs of Immune System—Primary and Secondary lymphoid organ Ontogeny and phylogeny of Lymphocytes—T and B Lymphocytes, Null
2	Cell of Immune System: Mononuclear cell and granulocytes Antigen presenting cell. Antigen and Heptanes Factors effecting immunogenicity Properties of Epitopes Antibodies—Structure, Types and function
3	Complement System: Role of complement system in immune response

	<p>Complements and Components and activation pathways</p> <p>Monoclonal antibodies Production characterization and applications in diagnosis, Therapy and basic research</p> <p>Antigen- Antibody interaction Avidity & affinity measurement.</p>
4	<p>Hypersensitivity: Definition Factor causing hypersensitivity Common Hypersensitivity Reaction—types, classification Auto Immune disease</p>
5	<p>Immunodiagnosics: Precipitation techniques Agglutination Fluorescence techniques ELISA RIA Double diffusion and Immuno-electrophoresis. Immuno Diagnostics- VDRL test, Widal test, RA factor, Blood grouping Rh typing Comb's test</p>
6	<p>Morphology of Viruses: General morphology and ultra structure of Viruses Capsids – Helical Symmetry, icosahedral symmetry and complex symmetry. Envelope— Glycoprotein and matrix protein Viral genome—their types of structure</p>
7	<p>Cultivation of Viruses: Cultivation of Viruses in embryonated eggs Experimental animals and cell culture Primary and secondary cell culture Suspension cell culture and monolayer cell cultures Assays of viruses- Physical and chemical methods of assays Serological methods Haemagglutination Haemagglutination inhibition, Complement fixation Immunofluorescence (IFA) ELISA RIA</p>
8	<p>Bacteriophages: Classification, Morphology and ultrastructure One step growth curve (Latent period, eclipse period and burst size) Life cycle—Lytic and Lysogenic cycles of bacteriophages</p>
9	<p>Animal Viruses: Classification and nomenclature Life cycles and other details of DNA Viruses— herpes, adeno and SV40</p>

	Life cycle and other details of RNA Viruses— Retroviruses, Oncogenic Viruses and Lentiviruses (HIV), Picorna, Ortho myxo and Paramyxo.
10	Mycology: Classification of Fungi Growth and isolation Mycoses (all types) Laboratory diagnosis of mycotic diseases. Immunity in fungal diseases and value of immuno diagnosis. Role of mycotoxin Antifungal agents Epidemiology of fungal diseases.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Microbiology: An Introduction, 9/E Tortora Publisher Pearson Education India, 2008

MOLECULAR BIOLOGY- MBL16207

UNIT	CONTENTS
1	Introduction Cell: Cell Organelles Mitochondria Organization of Respiratory Chain Cytoskeleton
2	Structure and Properties of DNA: History of DNA Discovery Nucleotide Structure Structure of DNA(A, B, & Z Forms) Discovery of DNA as the Genetic Material Denaturation and Renaturation of DNA Supercoils and Cruciforms: Tertiary structure in DNA Concept and Definition of the Genome C-value Paradox
3	Prokaryotic and Eukaryotic Genome Organization: Organization of Viral Genome Organization of Bacterial Genome Chromosome Structure in Eukaryotes Nucleosome Modle Euchromatin and Heterochromatin Chromatin Structure B Chromosomes Definitions of Genes

4	DNA Replication: Overview of DNA Replication Mechanism of DNA Replication
5	Gene Mutation, Repair, and Recombination: Types of Mutation Effects of mutation Molecular basis of Mutations Causes of Mutation DNA Repair Repair of Mutation Recombination

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Molecular Biology: Understanding the Genetic Revolution By David P. Clark, Nanette J. Pazdernik

ENZYMOLGY- EZY16201

UNIT	CONTENTS
1	Introduction to Enzymology: Enzymes and their characteristics Enzyme specificity Classification of enzymes Coenzymes Cofactor and activator factor affecting enzyme activity km value and its significance in enzyme reactions
2	Enzyme Interdiction: Meaning of enzyme interdictors Various types of enzyme interdictors Competitive Non competitive, Uncompetitive Mixed inhibitors and their uses in drug therapy Study of enzymatic reactions commonly employed in clinical laboratories.
3	Iso-Enzymes: Iso-enzymes Allosteric enzymes Intra cattalo's distribution of enzymes in relation to Metabolic pathways Enzymes in clinical diagnosis
4	Hormones: Hormones and their mode of action Peptides steroids, amino and derivatives acting as hormones Fatty and derivatives acting as hormones Hormones recreated by pituitary, thyroid, pancreas and adrenal glands Techniques employed in hormones assay

5	Radio Isotopes: Radio isotopes commonly used in medical sciences Application of radio isotopes Monitoring of radioactivity by use of Scintillation counters radio immune assay Handling and hazards of radiation envied by radio isotopes.
6	Enzymes and Co-enzymes: Introduction and difference Functions Estimation of important enzymes SGOT (AST) SGPT(ALT) Alkalline Phosphatase Acid Phosphatase Amylase, lactate dehydrogenase. CPK, CPK-MB

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Catalysis in Chemistry and Enzymology By William Platt Jencks
- B. Enzymology, by T. Devasena, Oxford University Press, 2010

DIAGNOSTIC MICROBIOLOGY- MBL16208

UNIT	CONTENTS
1	Classification of Bacteria: On the basis of different staining Grams Stain. ZN Stain On basis of their structure
2	Pre-remit of Sample Collections: General & disease specific Processing & storage.
3	Identification of Bacteria: Staphylococcus & Streptococcus including Pneumonococci—Characteristics, Morphology and Serological features Family Enterobacterial—Characteristics, Morphology and serological features Haemophilus bordetlla—Characteristics, Morphology and serological features Corynebacterium—Characteristics, Morphology and serological features Nessieria, Treponema—Characteristics, Morphology and serological features Leptospira, Mycoplasma, Chlamydia & Trieagnents—Characteristics, Morphology and serological features
4	Identification of Pathogenic & Nonpathogenic fungi: Yeast Dermatophytes Cryptocococci Histoplasma

	Nocardia Common lab fungal contaminants
5	Serological Tests in Diseases: Cholera Typhoid Tuberculosis VRL TPHA Satellitism ELISA PCR.
6	Urology: General morphology & ultra structure of virus and growth cycles. Viral genome: Their types & symmetry. Cultivation of virus in embryonated eggs, primary culture & secondary culture Assay methods : Physical & chemical Clinical diagnosis serological techniques for identification of bacteria TMV Bacteriophages. HIV. SV 40, Myxo & Paramyxovirus.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Reading 1 - Practical microbiology - Prof. C.B. Baveja.
- B. Reading 2 - Clinical pathology & bacteriology - Sachdev K.N.

BLOOD BANKING– BBN16201P

UNIT	CONTENTS
1	Practical I- Blood Bank Administration Record Keeping Computerization in blood transfusion services. Blood grouping ABO PH typing various techniques.
2	Practical II- Cross Matching Tube test Slide Test DU Test Sub Grouping Test
3	Practical III- Coomb's Test Direct coomb's test Indirect coomb's test Compatibility testing for blood transfusion cross matching test. 5% cell suspension and 10% cell suspensions. HIV and AIDS demonstration.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. <http://www.bbguy.org/education/notes/BBPrac.pdf>
- B. Blood Banking Transfusion Medicine: Basic Principles & Practice by Christopher D. Hillyer, Elsevier Books, Oxford, 2003

MOLECULAR BIOLOGY – MBL16206P

UNIT	CONTENTS
1.	Practical I- DNA replication, Transcription, Translation, Biosynthesis of proteins. Metabolism of Purine & Pyrimidine Nucleotides: Biomedical importance of purine & pyrimidine nucleotides, Biosynthesis of purines
2.	Practical II- Pyrimidines, Regulation of purine & Pyrimidine nucleotides. DNA recombinant technology & genetic engineering, Polymerase chain reaction (PCR) Regulation of gene expression. Isolation of mutant (UV/ NTG / HNO ₂ / Dyes) .
3.	Practical III- DNA isolation (plasmid & chromosomal). Agarose gel electrophoresis for DNA. Amplification of DNA / RNA by PCR. Restriction analysis of bacterial DNA
4.	Practical IV- Study of transformation process. Induction of β -galactosidase in E. coli. Enumeration of bacteriophage.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Molecular Biology By Michel Morange, Matthew Cobb
- B. Essentials of Molecular Biology 4e (paper) By George M Malacinski

ENZYMOLGY– EZY16201P

UNIT	CONTENTS
1	Practical I- Serum alkaline and Jhospha fase assays. Assay of serum transaminases. Assay of serum any lose. Determination of activity of clinically important enzymes – Alkaline phosphatase, Acid phosphatase, AST, ALT, Amylase, Lipase, LDH, CK, G^PD, Pyruvate kinase, Estimation of porphyrins and porphobilinogen in urine. Urine qualitative and quantitative analysis. Biochemical analysis of CSF, Amniotic fluid, Peritoneal fluid, Pericardial fluid, Pleural fluid, Synovial fluid, Semen etc.
2	Practical II- Assay of creative kinas'. Estimation of T3 and T4 hormones. Determination of alpha fetoprotein. Glycated hemoglobin (Hb, A, C) assay. Others important analytes in various body fluids. Study of factors influencing enzyme reaction . Type of inhibition shown by various inhibitors Determination of Km and Vmax of enzyme.
3	Practical III- Aldolase, 51- Nucleotidase Leucine amino peptidase Gamma glutamyl trans peptidase, Choline esterase, Enolase, Isocitrate dehydrogenase, Catalase, various isoenzymes etc. Estimation and standardization of Glucose, Urea, Cholesterol, Triglycerides, Phopholipids, Total lipid, Uric acid, Creatine , Creatinine, Ammonia, Ketone bodies, Glycosilated haemoglobin, Bilirubin,, Plasma haemoglobin , Myoglobin Investigations of Alkaptoneuria, Cystineuria, Pentoseuria, Glycogen storage diseases, Galactosemia.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Catalysis in Chemistry and Enzymology By William Platt Jencks
- B. Enzymology, by T. Devasena, Oxford University Press, 2010