

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
BCH16110	Endocrinology, Metabolic and Nutritional Biochemistry	70	30	4
MBL16115	Advanced Microbiology	70	30	3
BCH16111	Analytical and Physical Biochemistry	70	30	4
BBN16102	Blood Banking and Immunopathology	70	30	4
MLT16103	Lab Management and Techniques	70	30	3
PAT16103	Advanced Hematology and Immuno-Hematology	70	30	4
MBL16116	Immunology and Molecular Biology	70	30	4
MBL16115P	Advanced Microbiology (P)	35	15	2
BCH16111P	Analytical and Physical Biochemistry (P)	35	15	2
BBN16102P	Blood Banking and Immunopathology (P)	35	15	2
	TOTAL		850	32

YEAR II

Course Code	Course Title	Theory/ Practical	Continuous Assessment (Internals)	Credits
BOX16203	Biostatistics and Epidemiology	70	30	3
MBL16213	Systemic Bacteriology and Diagnostic Microbiology	70	30	4
BCH16210	Clinical Biochemistry	70	30	3
PAT16201	Histopathology and Cytopathology	70	30	4
PAT16202	Clinical Pathology and Cytogenetics	70	30	4
MBL16214	Medical Parasitology, Mycology and Virology	70	30	4
MBL16214P	Medical Parasitology, Mycology and Virology (P)	35	15	2
MBL16213P	Systemic Bacteriology and Diagnostic Microbiology (P)	35	15	2
BCH16210P	Clinical Biochemistry (P)	35	15	2
PAT16202P	Clinical Pathology and Cytogenetics (P)	35	15	2
DSR16201	Dissertation		100	2
	TOTAL		900	32

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

ENDOCRINOLOGY, METABOLIC AND NUTRITIONAL BIOCHEMISTRY – BCH16110

UNIT	CONTENT
1	General Concepts of Endocrinology: The endocrine system; hormones- chemical nature; classification; hormonal action- receptors; hormone receptor interaction; regulation of gene expression by hormones; second messengers (camp, GMP, Ca ⁺⁺) Protein kinase cascade; Concepts of hormones assay.
2	Pathology in Endocrine Systems: Abnormal Hormone Activity; Endocrine organ hypofunction; Endocrine organ hyperfunction.; Abnormality in hormone transport or metabolism; Abnormal hormone receptor binding and/or signal transduction; Neoplasms; Iatrogenic; Assessment of endocrine diseases; Endocrinal imaging.
3	Hypothalamus and Pituitary Gland: Anatomy; chemistry; functions; regulation; Diseases related to the hormones of these glands; Assessment of anterior and posterior pituitary.
4	Thyroid Gland: Anatomy; chemistry; synthesis; functions; regulation; thyroid function test in various abnormal conditions; parathyroid – anatomy; chemistry; synthesis; functions; regulations; diseases of parathyroid glands; Hormones involved in calcium and phosphate metabolism; Diseases related to its metabolism; Calcium chemistry and functions.
5	Adrenal Cortex and Medulla: Anatomy; chemistry; synthesis; metabolic effects; pathophysiology of the adrenal cortex; Assessment of adrenal functions; Gonadal hormones – anatomy, chemistry; functions; regulations and diseases related to these glands; Endocrinology of male and female infertility; pregnancy and lactation.
6	Gastrointestinal and Pancreatic Hormones: Chemistry; synthesis; metabolic effects; regulation; diseases related to the hormones of these glands; Detection of anomalies.
7	Introduction to Nutritional Biochemistry: Overview of course structure and assessment; General principles in nutritional science.
8	Nutrition: Nutritional requirements of carbohydrates; proteins and lipids; Deficiency states of carbohydrates, proteins and lipid; Minerals and their role in nutrition; RDA, Nutritional requirements of vitamins (fat and water soluble); Structure, functions, deficiency states, dietary source; Nutritional requirements of macro and microelements-functions, deficiency states, dietary source, RDA.
9	Dietary Fiber: Definition of dietary fibre; Cellulose, glucans, pectins, hemicelluloses, lignin, fructans; Resistant starch (RS) as dietary fibre; Examples of the physiological and metabolic effects of dietary fibre; Dietary fibre in disease prevention; Recommended intakes.
10	Nitrogen Fixation: Mechanism of nitrogen fixation; Symbiotic nitrogen fixation; Non-symbiotic nitrogen fixation; Genetic Basis of Nitrogen Fixation.
11	Fermentation: Types of fermentation; Pathway of fermentation; Anaerobic fermentation; Enzymes as fermentation products.
12	Nutrition in Health and Disease: Balanced diet-Regulations of food intake and energy storage; Disorder of nutrition-Malnutrition, malabsorption, obesity, starvation, deficiency diseases
13	Alcohol Metabolism: Alcohol dehydrogenase pathway; Microsomal ethanol oxidising system (MEOS); Dietary carbohydrates; Classification of dietary carbohydrates; The free sugars: Monosaccharide biochemistry.
14	Metabolism During the Fed-Fast Cycle: Discussion over fed-fast cycle; The central role of the liver in the metabolism of dietary macronutrients; Metabolism during the fed state; The postabsorptive state and the role of stored liver and muscle glycogen; Fasting and the role of

	skeletal protein; Starvation and the role of triglycerides and ketones; Catabolism of vital protein.
15	Interrelationship: Metabolic interrelationship between adipose tissue, liver & extra hepatic tissues; Clinical Importance; Key Junction Glucose – 6 – Phosphate, Pyruvate & Acetyl-Co-A; Unique metabolic profile of various organs.
16	Electron Transport & Oxidative Phosphorylation: Components of Electron Transport Chain; Respiratory Chain; Energy Coupling hypothesis; Proton- Gradient generation; Mechanism of ATP synthesis; Uncoupling of Oxidative Phosphorylation.
17	Metabolism of Purines & Pyrimidines: (a) Purine Biosynthesis - Formation of PRPP, Biosynthesis of Inosine-mono Phosphate, Purine Nucleotide inter conversion, Regulation of Purine biosynthesis (b) Pyrimidine Biosynthesis - Assembling of Pyrimidine Nucleus, Regulation of Pyrimidine Biosynthesis, Salvage Pathway for Purine & Pyrimidine Biosynthesis, Related Disorders.
18	Glycogen Storage Diseases & Galactosuria: Introduction; Different types of Diseases - Pompe's Disease; Cori's Disease; McArdle's Disease; Andersen's Disease; Hers' Disease; Taruis Disease; Galactosuria
19	Intrinsic Disorders of Red Cells, Haemoglobin and Porphyrins Sphingolipidases: Disorders of Red Cells - Hemolytic Anemia, Sickle Cell Anemia, Thalassaemia; Disorders of Hemoglobin - Haemoglobinuria, Other Haemoglobinuriopathies; Disorders of Porphyrins – Introduction; Different types of Porphyria.
20	Aminoaciduria: Definition; Types of Aminoaciduria; Overflow Aminoaciduria; Renal Aminoaciduria
21	Gout & Genetic Defects in Urate Metabolism: Introduction; Types of Gout – Primary, Secondary; Treatment; X-Linked Disorder

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Griffin, J.E. and Ojeda, S.R. (Eds.), “Textbook of Endocrine Physiology”, New York: Oxford University Press.
- B. Baulieu, E.E. and Kelly, P.A. (Eds.), “Hormones: from molecules to disease” New York: Chapman & Hall.
- C. Martin H. Steinberg: Disorders of Hemoglobin: Genetics, Pathophysiology & Clinical Management: Cambridge University Press.
- D. Atlas, R.M., Barthas, R. Microbial Ecology: Fundamentals and Applications. 3rd ed. Benjamin-Cummings Publishing.

WEB LINKS:

- A. <http://www.ncbi.nlm.nih.gov/books>.
- B. <http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/thyroid/pth.html>.
- C. <http://ezinearticles.com/?Insulin---The-Fat-Hormone&id=1874267>

ADVANCED MICROBIOLOGY – MBL16115

UNIT	CONTENT
1.	Introduction to Microbiology: History & scope of microbiology, safety methods in microbiology Laboratory; First aid in microbiology laboratory; Universal safety precautions; Safety cabinets; Common glassware for microbiology and its cleaning and sterilization;

	Disposal of waste materials in microbiology.
2.	Sterilization and Disinfection: Physical methods- Heat (Autoclaves, hot air oven), Filtration, Radiation; Chemical methods- Disinfectants, Antiseptics, Testing of disinfectants; Disinfection of thermo labile equipments; Sporicidal agents; Mycobacterial disinfection; Quality control in sterilization.
3.	Microscope: Principle; Methods of safe working; Different parts; Preparation of smears for examination; Applications of following microscopes –Bright field, dark ground, phase contrast, differential interference contrast, fluorescent, electron (scanning, transmission (STEM), polarizing, tunneling and confocal; Micrometry.
4.	Bacterial Morphology: Ultra structure of bacterial cell, cell wall, capsule, flagella, fimbriae, bacterial spores, cytoplasmic inclusions; Morphologic changes during growth; Classification of bacteria- Definitions, Criteria for classification of bacteria, Identification & classification system, Description of the major categories & Groups of bacteria; Sub typing & its application.
5.	Staining Methods for Bacteria: Principles; Preparation of stains and reagents; Preparation of smears; Modification of following staining methods- Simple staining, Differential staining (Gram staining, AFB staining), Negative staining, Fluorochrome staining, Staining of Volutin granules, Staining of spirochetes, Spore staining, Capsular staining, Flagellar staining.
6.	General Bacteriology: Classification of Medically important Bacteria; Growth, survival & death of microorganisms- Survival of microorganisms in the natural environment, Meaning of growth, Exponential growth, Growth curve, Maintenance of cells in the exponential phase, Definition & measurement of death; Cultivation of microorganism- Requirements for growth, Sources of metabolic energy, Nutrition, Environmental factors affecting growth, Cultivation methods.
7.	Bacterial Metabolism: Role of metabolism in Biosynthesis & growth; Focal metabolites and their interconversion; Assimilatory Pathways; Biosynthetic Pathways; Regulation of Metabolic Pathways.
8.	Bacterial Genetics: Bacterial genome; Extra chromosomal genome; Phenotypic and genotypic variations; Regulation and expression of gene activity; Genetic transfer in bacteria; Hfr strains; R factor; Conjugation in Gram positive and Gram negative bacteria; Bacteria in genetic engineering; Mutation & gene rearrangement.
9.	Culture Media: Classification of culture Media; Preparation of Culture Media; Quality Control of Culture Media; Inoculation; Incubation & purification methods in bacteriology; Quantitation of bacterial growth; Preservation of bacteria.
10.	Biochemical Tests for Identification: Principle, Media & Reagents, Method; Interpretation & Quality Control of Biochemical tests; Tests for metabolism of carbohydrates; Tests for metabolism of proteins and amino acids; Tests for enzymes; Tests for metabolism of fats; Rapid identification systems.
11.	Antibiotics in Laboratory Medicine: Antibiotics & mechanism of action MIC & MBC (Minimum inhibitory concentration & Minimum bactericidal concentration); Invitro susceptibility tests diffusion methods; Mechanism of antibiotic resistance; Detection of methicillin resistant staphylococci.
12.	Principles of Disease and Epidemiology: Introduction to epidemiology with brief aspect on pathology, infection, disease, normal flora & opportunist; Detailed aspect of host-parasite relationship; Patterns of diseases-development of the disease, predisposing factors; Spread of infection- Reservoirs, transmission, portals of exit; Epidemiology of nosocomial infections & the compromised host; Mechanism of pathogenicity.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Microbiology: An Introduction, Eighth Ed. By Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Hardcover: 944 pages, Publisher: Benjamin Cummings.

- B. Tietjen L, Bossemeyer, D, McIntosh N. Infection prevention: Guidelines for healthcare facilities with limited resources. JHPIEGO. (JHPIEGO Corporation, Brown's Wharf, 1615 Thames Street, Baltimore, MD, 21231, USA) 2003.
- C. Foundations in Microbiology, Basic Principles, by Talaro, Kathleen Park.

WEB LINKS:

- A. <http://www.microbeworld.org/history-of-microbiology>.
- B. <http://www.utexas.edu/safety/ehs/resources/info.universal.pdf>.
- C. <http://generalbacteriology.weebly.com/sterilization-and-disinfection.html>.

ADVANCED MICROBIOLOGY (P) – MBL16115P

1. The microscope
2. Sterilization and disinfection
3. Illustration of staining techniques
4. Identification of organism by biochemical reactions
5. Solid and liquid culture media
6. Staining Techniques
 - Gram stain
 - Acid fast stain
 - Albert's Staining
 - Capsule Staining
 - Spore Staining
 - Negative Staining
7. Media for Routine Cultivation of Bacteria
8. Culture Techniques
9. Control of Microbial Growth
10. Anti-microbial agents & Sensitivity Testing
11. Systemic Bacteriology
 - Identification of Staphylococcus aureus
 - Identification of Streptococcus Pneumonia
 - Identification of β -haemolytic streptococcus
 - Identification of Corynebacterium diphtheriae
 - Identification of Lactose fermenting Enterobacteriaceae

ANALYTICAL AND PHYSICAL BIOCHEMISTRY – BCH16111

UNIT	CONTENT
1	Biophysical Chemistry: Electrolytes - Definition, ionization of weak acids, weak bases pH, Henderson Hasselbach equation; Buffer systems - definition, titration curve of weak acids, buffering capacity, physiological buffers, Respiratory and metabolic acidosis and alkalosis; Law of mass action - K_{eq} , activity coefficient; Osmosis - definition, osmotic crisis, transportation across membrane by membrane proteins; Dialysis - definition, purification of proteins on basis of solubility, size, charge and binding affinity; Definitions - viscosity,

	surface tension; Donnan equilibrium - K_{eq} , membrane hydrolysis.
2	Biological Oxidation & Bioenergetics: Protein folding in terms of free energy changes, Entropy, Laws of Thermodynamics useful thermodynamic function for understanding enzymes, Biomedical Importance, Redox Potential, Enzymes Involved In Oxidation, and Reduction; transport of molecules active and passive; involvement of ATP in biological systems.
3	Radioactivity: Radioactivity- types of radioactive decay with examples; Radioactive half life; Units of radioactivity; Application of radioisotope in clinical chemistry.
4	Immunoassays and Application To Biochemistry: Radio Immuno - Assays (RIA); Determination of Hormones by Using Radio Immuno assays (RIA); Nonisotopic Immuno Assays; Homogeneous Enzyme Immuno Assays; Heterogeneous Enzyme Immuno Assays; Enzyme Linked Immuno-Sorbant Assay (ELISA); Chemiluminescence & Bioluminescence; Microparticle Enzyme Immuno assay (MEIA); Fluorescence Polarization Immuno assay (FPIA); Radio Active Energy attenuation (REA) Assays.
5	Chromatography and Application in Biochemistry: Chromatography Definition; Types of Chromatography- Adsorption Chromatography; Partition Chromatography; Ion-exchange Chromatography; Gel Filtration; Affinity Chromatography; Paper Chromatography & its Applications; Thin Layer Chromatography & its Applications; Column Chromatography & its Applications; High Performance liquid Chromatography (HPLC) & its Applications- Diagnostic Application of DNA Probes, Clinical Significance, Application of DNA (RNA) Probes, Separation & Identification of Amino Acids by Circular Paper Chromatography.
6	Electrophoresis: Definition, General Methodology; Factors affecting migration of charged particles; Proteins separation by gel Electrophoresis; Isoelectric Focusing; Two Dimensional Electrophoresis; Protein purification and Evaluation – total protein, total activity, specific activity, yield, purification level; Densitometry; Blot Techniques- Southern & Northern Techniques; Ultracentrifugation, valuable for separating Biomolecules and Determining their masses; Fractionation of Serum Proteins by Agarose Gel Electrophoresis; Fractionation of Lipoproteins by Agarose gel Electrophoresis; Western Blotting Techniques for Detection of proteins Separated by gel Electrophoresis.
7	Spectrophotometry: Protein Mass Determination by Mass Spectrometry; Protein Purification; Protein analysis; Protein Sequence; Immunological techniques For Protein Investigation; Antibodies to Specific Proteins; Enzyme Linked Immuno sorbent assay; NMR spectroscopy & X- ray Crystallography for three Dimensional Protein structure.
8	Fluorimetry: Principles; Factors Affecting Fluorescence; Fluorescent Markers – Visualization of Proteins in the Cell; Components of Fluorimeter; Advantage of Fluorimeter.
9	Reflectance Photometry & Immunochemical Techniques: Introduction & Applications; Flame Photometry; Immunochemical Techniques.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Biophysical Chemistry, By James P. Allen, 2009.
- B. Textbook of Biophysical Chemistry, By U.N. Dash, 2006.
- C. The Physical Basis of Biochemistry: The Foundations of Molecular Biophysics, By Peter R. Bergethon, 2010.
- D. Physical Biochemistry: Principles and Applications, By David Sheehan, 2009.

WEB LINKS:

- A. http://books.google.co.in/books?id=4lmzY1D4kxMC&printsec=frontcover&dq=biophysical+chemistry&hl=en&sa=X&ei=x_LJU7L4L4P68QX92YCwDQ&ved=0CBoQ6AEwAA#v=onepage&q=biophysical%20chemistry&f=false
- B. <http://jcp.bmj.com/content/44/3/238.full.pdf>.

ANALYTICAL AND PHYSICAL BIOCHEMISTRY (P) – BCH16111P

1. Cleaning of Glassware
2. Collection of blood with evacuated or vacuum tubes
3. Preparation of 2/3 N Sulfuric Acid from 1N sulfuric acid. Required Quantity 150ml.
4. Preparation of protein free filtrates of blood by using a micro method.
5. Water distillation Plant
6. Preparation of 200ml Phosphate buffer (m/15, pH-7.45) and Determination of pH by using a pH meter.
7. Sterilization
8. ELISA (Indirect method)
9. ELISA (Sandwich method)
10. Determination of Electrolytes

BLOOD BANKING AND IMMUNOPATHOLOGY – BBN16102

UNIT	CONTENT
1	Blood Banking: Basic principles of Immunohaematology; methods of collection of blood; preparation and labeling of anticoagulant bulbs; human blood groups antigens and antibodies; ABO Blood group systems; sub- groups; source of antigens and types of antibodies; Rh Blood group systems; types of antigens; mode of inheritance; types of antibodies; Other blood group antigens; Blood collection; selection and screening of donor; collection of blood; various anticoagulants; storage of blood; materials and reagents used for different investigations in blood bank; HDN; Quality assurance in Transfusion Service.
2	Storage & Transport: Storage of blood ; changes in blood after storage; Gas refrigerator; lay out of a blood bank refrigerator; transportation; Compatibility testing: purpose; single tube compatibility techniques using AHG reagent; emergency compatibility testing; difficulties in cross matching; labeling & issuing cross-matched blood.
3	Blood Component: Introduction, overview of 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.
4	Blood Grouping Techniques: Antibody screening and Identification; Compatibility testing; Blood collection and processing; Preservation and storage of blood; Blood component preparation and therapy; Screening tests; New generation equipments in blood bank.
5	Transfusionology: Blood Bank management and planning the receiving and recording of blood samples; indexing; maintaining blood bank records; legal aspects in starting and running of a blood bank; knowledge of maintenance and working of Blood bank refrigerators, Welkin coolers, refrigerated centrifuge incubators, ovens, autoclaves etc; Transfusion reactions- recognition and investigations; actions to take when transfusion reaction occurs; criteria used while selecting a blood donor; Special investigations in Transfusion technology.
6	Records Blood Donor & Maintenance of Blood Bank Records: Blood donation record book; recording results; blood donor card; blood bank temperature sheet; blood bank stock sheet; blood transfusion request form; Quality control in blood banks- specimen collection; risk assessment for AIDS and serum hepatitis.

7	Immunopathology: History of Immunology and Immunopathology; Review of Basic Immunology; Vaccines; Immunodeficiencies- B cell, T cell , Combined, Phagocytic & Compliment & Hypersensitivity reactions; Cancer and the immune system; Autoimmune diseases; Clinical Laboratory methods for the detection of antigens and Antibodies; Clinical Laboratory methods for the detection of cellular immunity; Histocompatibility testing; Molecular genetic techniques for clinical analysis of the immune systems; Experimental animal methods; Raising antibodies in laboratory animals; Recombinant DNA Technology; Gene transfer to Mammalian cells; Separation serum protein by different electrophoresis; Separation of different cells in the blood.
8	Immunology and Serology: Disease of immune system: AIDS, Auto immune diseases; Hormones- thyroid hormone, growth hormone, insulin, Glycosylated Hemoglobin, COOMB'S test; Direct and Indirect test; Titration of Anitbody.
9	Transplantation Immunology: Introduction; types; transplantation techniques; transplant rejection; Immune response to infectious diseases.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Chrostopher D. Hillyer (2007). Blood Banking and Transfusion Medicine: Basic Principles & Practice. Elsevier Health Sciences.
- B. Morris Fishbein, M.D., ed. (1976) "Blood Banks". The New Illustrated Medical and Health Encyclopedia.
- C. Gartner, L.P., & Hiatt, J.L. (2007) Color Textbook of Histology (3rd ed.) Philadelphia, PA: SAUNDERS Elsevier.
- D. Lock, Margaret M. (2002). Twice Dead: Organ Transplants and the Reinventions of Death. Berkeley: University of California Press.

WEB LINKS:

- A. http://www.who.int/bloodsafety/Manual_on_Management,Maintenance_and_Use_of_Blood_Cold_Chain_Equipment.pdf.
- B. http://www.psbcc.org/hematology/03_index.htm.
- C. http://www.bloodindex.org/blood_bank_functions.php.

BLOOD BANKING AND IMMUNOPATHOLOGY (P) – BBN16102P

1. ABO Blood grouping – cell grouping and serum grouping
2. Rh typing methods
3. Cross matching techniques
4. Screening tests done in donors
5. Collection and storage of blood in blood bank
6. Separation of packed red cells, FFP and cryoprecipitate
7. Examination of Urine - Routine and Special tests
8. Examination of Stool - Routine and Special tests
9. Banding techniques
10. Identification of human chromosomes

11. Karyotyping
12. Direct chromosome preparation of bone marrow cells
13. Sex chromosome bodies

LAB MANAGEMENT AND TECHNIQUES – MLT16103

UNIT	CONTENT
1	Laboratory: Role of laboratory in human health and diseases; Human diseases and methods of diagnosis; Laboratory at different level (National/State/District); Duties and responsibilities of laboratory personnel; Laboratory services are a backbone of health care delivery system; Types of laboratory, Laboratory management; prevention of transmission of pathogens; Role of technician.
2	Laboratory Glassware, Chemicals and Equipment: General Principles of Care, storage and Cleaning of general and volumetric Glassware ; Making Simple Glassware in the Laboratory; Care of equipment and apparatus; Laboratory chemicals – Proper use, care, storage and labelling; Different grade of chemicals, preparation of solution and reagent; Buffer: preparation of buffer; Specimen handling : Appropriate container; Method of collection; Method of transportation; Method of preservation and disposal of laboratory waste.
3	Laboratory Instruments: Basic knowledge about the working principles, uses and care of laboratory Instruments : Balance, pH Meter, Centrifuge, Cyclo -mixer, Magnetic stirrers, Spectrophotometer, Microscopes (Optical and Electron), Distillation plant, Flame photometer, Laminar flow, Autoclave.
4	Laboratory techniques: Electrophoresis, fluorescence spectrophotometer, Densitometry, Chromatography, Blot techniques.
5	Laboratory automation: Continuous and Discrete analyzers; Green Laboratory: Disposal of laboratory waste; Disinfection of laboratory; Sterilization of some laboratory apparatus.
6	Lab Management: Ethics of the pathological clinics; Personality development and patient relationship; reports writing; Accountancy in clinical pathology Hospital Management; Operation ethics; Social ethics; Proper handling of instruments.
7	Laboratory Planning: General principles; Laboratory goals; Operational data; Market potential; Selection of area; Competition; Laboratory trends, Space requirements, Designing of laboratory sections; Staff and their duties, Work schedule and workload assessment.
8	Laboratory Safety: General principles of safety programmes; First aid and safety measures for Mechanical, Electrical, Chemical, Radioactive and Biological hazards; Universal safety precautions.
9	Quality control and quality assurance: Quality control and quality assurance in laboratory of- (a) Biochemistry, (b) Microbiology, (c) Haematology and Blood Banking (d) Histopathology and Clinical Pathology; Total quality management: Frame work, Quality control chart, Levy-Jenning and Cusum charts, Reference range; Current trends in laboratory accreditation. Medico legal problem.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Basic Clinical Laboratory Techniques, Barbara H. Estridge, Anna P. Reynolds Cengage Learning; 6 ed.
- B. Laboratory Management and Techniques, John Alfred Edwards, Butterworths, 1960.
- C. Basic Medical Laboratory Techniques: Medical Lab Technician Series, Barbara H. Estridge, Anna P. Reynolds, Norma J. Walters, Cengage Learning, 2000.

WEB LINKS:

- A. <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5114a1.htm>.
- B. <http://safety.uchicago.edu/labpersonnel/index.shtml>
- C. <http://www.aarogya.com/health-resources/health-programs/2471-public-health-labs.html?showall=1>.

**ADVANCED HEMATOLOGY AND IMMUNO-HEMATOLOGY –
PAT16103**

UNIT	CONTENT
1	Blood Cells: 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 with respect to normal & diseased state; White blood cells & platelets: Morphology count & methods of isolation; Effect on count & morphology of cell by the physiochemical parameters and diseased state & the relevance of condition of the diseases.
2	Physiological Variations in Blood Components: Introduction; Physiological variations in hemoglobin; Packed cell volume; Erythropoietin; Leukocyte count; platelets count; normal red cell values.
3	Anaemia: Definition & courses, Types of anemia & their classification; Physiochemical , characteristic features & etiology of aplastic anemia, hemolytic, megaloblastic; clinical features & diagnosis of anemia; Leukaemia: Definition (in general) & their etiology; Classification of leukemia; FAB classification; Etiologies, physiochemical features of different Type of leukemia's with reference to clinical states; Diagnosis of different types of leukemia's.
4	Coagulation Studies: General pathways (intrinsic & extrinsic); Properties (physiochemical) mode of action of coagulation factors; Platelet studies, platelet function tests (for different Coagulation factors); Effect of promoters & inhibitors at diff steps in coagulation, their solution & mode of action; Diseases associated with coagulation disorders, their etiology & characteristics features.
5	Cytochemical Staining Procedure in Various Hematopoietic Disorders: Bone marrow; bone marrow aspiration; bone marrow biopsy; bone marrow preparation; staining of bone marrow preparation; Romanowsky stains; Pan-optic staining.
6	Radioisotopes in Hematology: Introduction; substances and equipment for radioisotope calculation; measurement of blood, red cell and plasma volume; measurement of total blood volume; estimation spleen red blood cells, other formulas for isotopes in hematology; plasma iron clearance test; leukocytes imaging and imaging methods including Pet scan.
7	Safety Measures for Handling Radioisotopes: Introduction; radioisotopes in hematology; General safety guidelines; special guidelines; special recommendations, transport of radioactive material, storage of isotopes; radioisotope properties and precautions; classification of radioisotope laboratories.
8	Molecular Diagnosis in Hematology: Introduction; an overview of molecular biology; extraction of Nucleic acids: the Starting point for Molecular assays; Polymerase chain reaction: the indispensable molecular techniques; DNA Sequencing: the technique Driving the Genomic revolution; Blotting and Array methods; Flowcytometry; Fluorescence in situ hybridization (FISH); Immunophenotyping; other Molecular techniques in Haematology-applications of PCR in hematology.
9	Quality Assurance in Hematology: Introduction; quality vs. quality assurance; elements of quality assurance; external quality control; laboratory accreditation.

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Hematology: Basic Principles and Practice, Hoffman R, Benz EJ Jr, Silberstein LE, Heslop HE, Weitz JI, eds. 6th ed. Philadelphia, PA: Saunders Elsevier; 2012.
- B. Hemorrhagic disorders: Coagulation factor deficiencies, Goldman L, Schafer AI, eds. Goldman's Cecil Medicine. 24th ed. Philadelphia, PA: Saunders Elsevier; 2011.
- C. The ABC of CBC: Interpretation of Complete Blood Count and Histograms, D.P. Lokwani, JP Medical Ltd., 2013.
- D. Blood: Principles and Practice of Hematology, Volume 1, Thomas P. Stossel, Robert I. Handin, Samuel E. Lux, Thomas P. Stossel, Lippincott Williams & Wilkins, 2003.

WEB LINKS:

- A. <http://labtestonline.org/understanding/analytes/blood-smear/details/start/I>
- B. <http://www.jpathinformatics.org/article.asp?issn=21533539;year=2012;volume=3;issue=1;spage=13;epage=13;aulast=Rames>.
- C. <http://themedicalbiochemistrypage.org/bloodtests.php>.

IMMUNOLOGY AND MOLECULAR BIOLOGY – MBL16116

UNIT	CONTENT
1.	Introduction to Immune System: Introduction, History of immunology; Concept of Immunity & Immune response; Innate immune system-properties and mechanism, non specific defense system; Adaptive immune system-properties and mechanism, cells involved, MHC and its role; Memory, specificity, diversity, self vs non-self discrimination; Structure and functions of primary and secondary lymphoid organs; Cells Involved in Immune Responses: Phagocytic cells and their killing mechanisms; T and B lymphocytes; Differentiation of stem cells and idiotypic variations. Nature of Antigen and Antibody: Antigen vs Immunogen, Haptens; Structure and functions of immunoglobulin's; Isotypic, allotypic and idiotypic variations.
2.	Complement system & Hypersensitivity: Role of complement system in immune response; Complement components & activation pathways; Monoclonal antibodies-production, characterization & application in diagnosis, therapy & basic research; Important parameters of serological test; Avidity & affinity measurement; Definition of Hypersensitivity, Classification of Hypersensitivity; Factors causing hypersensitivity; Common hypersensitivity reaction; Classification & types of hypersensitivity reaction; Autoimmune diseases.
3.	Immunodiagnosics: Precipitation techniques & its application; Procedure, interpretation & application of agglutination, compliment fixation, neutralization & opsonisation; Fluorescence techniques; ELISA; RIA; Double diffusion & Immuno electrophoresis; Procedure & interpretation of VDRL test, WIDAL, Leptospira antibody test, Cryptococcal antibody test, RA Factor, Blood grouping, Rh typing, Coomb's test; Clinical laboratory methods for- Detection of cellular immune function; Delayed hypersensitivity skin tests; Assay for lymphocytes; Flow cytometry and cell sorting.; Monoclonal antibodies, hybridoma technique, purification & characterization, application in biomedical research, clinical diagnosis.
4.	Prophylactic Immunization: Concept & definition of immunization; Types of immunization; Introduction to vaccines in detailed; Types of vaccines; National immunization schedule; Vaccines- immunoprophylaxis & immunotherapy; Types of vaccines; Immunity against bacterial, viral, fungal & parasitic diseases, advances in the

	development of vaccines.
5.	Fundamentals of Molecular Biology: Introduction and history; Continuity of life- heredity, variation; Transmission genetics; Mendel's laws of inheritance; Mendel's gene transmission; The chromosome theory of inheritance; Patterns of inheritance- Incomplete dominance, Multiple allelism, Quantitative inheritance; Recombination; Physical evidence of recombination; Deoxyribonucleic Acid (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.
6.	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.
7.	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.
8.	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.
9.	Nucleic Acid Analysis: Extraction; Purification and analysis of mRNA from eukaryotic cells; Methods for synthesis of double strand cDNA; Expression profiling; Transcriptome analysis; RT PCR and Real Time PCR; Rapid DNA sequencing techniques like Sanger's dideoxynucleotide, partial ribonucleotide substitution; Maxam and Gilbert's method; Pyrosequencing and single molecule sequencing; Genome; Genome sequencing; DNA Sequence Characterization (Open reading frames, promoters, coding frames).

LEARNING SOURCE: Self Learning Materials

ADDITIONAL READINGS:

- A. Really Essential Medical Immunology Arthur Rabson, Iwan. M. Roit, Peter. J. Delves Second Edition.
- B. Introduction to Medical Immunology Edited by Gabriella Varella Medical University of South Carolina Charleston, South Carolina.
- C. Essential Immunology by Peter. M. Delves and Iwan. M Roitt Tenth Edition.
- D. Kuby Immunology Judy Owen (Haverford College), Jenni Punt (Haverford College), Sharon Stranford (Mount Holyoke College)

WEB LINKS:

- A. <http://www.uth.tmc.edu/pathology/medic/immunology/Immuno/ImmunoTimeline.pdf>.
- B. <http://en.wikipedia.org/wiki/Lymphaticsystem>.
- C. <http://www2.nau.edu/~fpm/immunology/documents/Ch-04000.pdf>.