CBCS SYLLABUS FOR B. VOC IN MEDICAL LABORATORY TECHNICIAN (MLT)

PROGRAMME TEMPLETE B. VOC IN MLT

GAUHATI UNIVERSITY

SEMESTER	CORE COURSE (12 PAPERS, 72 CREDITAS)	ABILITY ENHANCEMENT CUMPOLSURY COURSE (AECC) 2 PAPERS, 8 CREDITS	SKILL ENHANCEMENT COURSE (SEC) 4 PAPERS, 16 CREDITS	DESCIPLINE SPECIFIC ELECTIVE (DSE) 6 PAPERS, 36 CREDITS
I	MLT-VC-1016	ENG-AE-1014		
	MLT-VC-1026			
	MLT-VC-1036			
II	MLT-VC-2016	ENG-AE-2014		
	MLT-VC-2026			
	MLT-VC-2036			
III	MLT-VC-3016		XXX-SE-3XX4	
	MLT-VC-3026			
	MLT-VC-3036			
IV	MLT-VC-4016		XXX-SE-4XX4	
	MLT-VC-4026			
	MLT-VC-4036			
V			XXX-SE-5XX4	MLT-VE-5016
				MLT-VE-5026
				MLT-VE-5036
VI			XXX-SE-6XX4	MLT-VE-6016
				MLT-VE-6026
				MLT-VE-6036

SEMESTER-I

PAPER: MLT-VC-1016: BASIC ANATOMY AND PHYSIOLOGY (6 CREDITS)

Overview and key learning outcomes: This paper will help the students to understand the basics and fundamentals of cells, tissues, different systems of the body including GI system, Respiratory system, cardiovascular system, urinary system, reproductive system endocrine system etc. Further the students have to learn about the medical terminology used in human anatomy, functions of different systems of human.

Total Marks: 100

UNIT	UNIT TITLE	Credits and Marks
I	**Introduction to human Anatomy & Physiology:** o Definition of anatomy and its divisions, o Terms of location, o Positions and planes o Anatomical terminology o Different parts of the body	**1 Credits (15 Marks)**
II	**Cell and its organelles:** o Structure o Functions o Cell Divisions **Tissue –** o Definitions, Classification with examples o Functions of different types of tissues. o Epithelium – definitions, classification, describe with examples o Different organs of human body o Membranes. o Glands – Classification, describe serous & mucous glands with examples.	
III	**Gastro-intestinal System** o Physiology & anatomy of mouth, Oral cavity (lip, tongue (with histology), tonsil, dentition, phyrinx, salivary glands, Waldeyer's ring) Oesophagus, stomach, small and large intestine, liver, gall bladder, pancrease.	

IV	**Respiratory System** o Parts of Respiratory System, nose, nasal cavity, larynx, trachea, lungs, bronchopulmonary segments, names of paranasal air sinuses, Physiology of respiration.	
V	**Cardiovascular System and Lymphatic System** o Anatomy of physiology of heart, Heart size, location, chambers, exterior & interior, blood supply of heart, Systemic and pulmonary circulation, Branches of aorta, common carotid artery, axillary artery, brachial artery, superficial palmar arch, femoral artery, internal iliac artery. Peripheral pulse o Inferior venacava, portal vein, portosystemic anastomosis, Great saphenous vein, Dural venous sinuses, lymphatic system – cistern chyli & thoracicduct Histology of lymphatic tissue, Names of regional lymphatics, axillary and inguinal lymph nodes in brief.	**1 Credits (15 Marks)**
VI	**Musculo-skeletal System** o Cartilage – types with example & histology, o Bone – Classification, names of bone cells, parts of long bone, microscopy of compact bone and spongy bone, names of all bones, vertebral column, intervertibral disc. o Joints – Classification of joints with examples, synovial joints (in details for radiology). o Muscular system – Classification of muscular tissue.	
VII	**Different types of body fluids, secretions and excretions** o Pleural fluid o Ascitic fluid o Synovial fluid o Pericardial fluid o Cerebrospinal fluid	**1 Credits (15 Marks)**
VIII	**Urinary System** o Anatomy of Kidney, Ureter, Urinary bladder, male and female urethra. o Histology of Kidney, ureter and urinary bladder. o Formation of Urine	

IX	**Reproductive System** o Parts of male reproductive system, testis, vas deferens, epididymis, prostate. Spermatogenesis Parts of female reproductive system – uterus, fallopian tubes, ovary, mammary glands – gross. Oogenesis, Ovulation, Menstrual cycle.	**1 Credit (15 Marks)**
X	**Endocrine system** Name of all endocrine glands, detail on pituitary gland, thyroid gland, parathyroid gland, suprarenal gland – (gross and histology).	
XI	**Nervous System** Neuron – classification of NS, cerebrum, cerebellum, midbrain, pons, medulla oblongata, spinal cord with spinal nerve, Meninges, Ventricles & cerebrospinal fluid. Names of basal nuclei Blood supply of brain, Cranial nerves, sympathetic trunk & names of parasympathetic ganglia.	
XIII	**Sensory Organs** Theory – Skin: skin histology, Appendages of skin, Eye: parts of eye & lacrimal apparatus. Ear: parts of ear – external, middle and inner ear and contents.	

PRACTICALS: **20 Marks (1 Credit)**

SL. NO	TOPIC
I	Histology of types of epithelium, Histology of serous, mucous & mixed salivary gland. Histology of thin and thick skin.
II	Demonstration of parts of respiratory system.
III	Demonstration of heart and vessels in body, Histology of lymph node, spleen, tonsil & thymus, Normal chest radiograph showing heart shadows.
IV	Demonstration of heart and vessels in body, Histology of lymph node, spleen, tonsil & thymus, Normal chest radiograph showing heart shadows.
V	Demonstrations of reflections.
VI	Histology of three types of cartilages.
VII	Demonstration of parts of urinary systems.
IX	Demonstration of the glands.

INTERNAL ASSESSMENT **20 Marks (1 Credits)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER-I

PAPER: MLT-VC-1026: BIOCHEMISTRY - I (6 CREDITS)

Overview and key learning outcomes: This paper will help the students to identify various laboratory glassware, plastic ware and instruments along with care and maintenance of equipments and apparatus used in the laboratory. The students have understand the phlebotomist's duties towards identification of patient and taking their consents before withdrawing blood specimens. In addition to that preparing appropriate site for blood samples.

Total Marks: 100

UNIT	UNIT TITLE	Credits and Marks
I	1. Brief introduction about Biochemistry & Laboratory apparatus, pipettes – different types (Graduated, volumetric, Pasteur, automatic etc.), calibration of glass pipettes, Burettes, beakers, petri dishes, depression plates. Flasks – different types, Volumetric, round bottomed, Erlemeyer conical etc.). Funnels – different types (Conical, Buchner etc. Bottles – Reagent bottles – graduated and common, Wash bottles – different type, Specimen bottles etc. Measuring cylinders, Porcelain dish. Tubes – Test tubes, Centrifuge tubes, test tube draining rack Tripod stand, wire gauze, Bunsen burner Cuvettes, significance of cuvettes in colorimeter, cuvette for visible and UV range, cuvette holders racks – Bottles, Test tube, pipette Dessicator, stop watch, rimers, Scissors. Dispensers – reagent and sample Any other apparatus which is important and may have been missed should be covered. Maintenance of lab glass ware and apparatus. Glass and plastic ware in laboratory. * use of glass: significance of borosilicate glass; care and cleaning of glass ware, different cleaning solutions of glass. * care and cleaning of plastic ware, different cleaning solutions	**1 Credit (15 Marks)**

II	Instruments (Theory and demonstration) Diagrams to be drawn. Water bath: Use, care and maintenance Water distillation plant and water deionizers: use, care and maintenance. Refrigerators, cold box, deep freezers – Use, care and maintenance Reflux condenser: Use, care and maintenance Centrifuges (Theory and Demonstrations) Diagram to be drawn. Definition, principle, Svedberg unit, centrifugal force, centrifuge field rpm, ref. Conservation of G to rpm and vice versa. Different types of centrifuges: Use, care and maintenance of a centrifuge. Laboratory balances [Theory & Practicals] Diagram to be drawn Manual balances: Single pan, double pan, triple balance. Direct readout electrical balances Use, care and maintenance. Guideline to be followed and precautions to be taken while weighing Weighing different types of chemicals, liquids Hygroscopic compounds etc. Colorimeter and spectrophotometer (Theory and Practical) Diagram to be drawn. Principle, parts of diagram. Use, care and maintenance	**1 Credit (15 Marks)**
III	**Standard solutions**. Technique for preparations of standard solutions. e.g. Glucose, urea, etc. Significance of volumetric flasks in preparing standard solutions. Volumetric flasks of different sizes, Preparations of standard solutions of deliquescent compounds ($cacl_{2,}$ Potassium carbonate, sodium hydroxide etc.)	**1 Credit (15 Marks)**
IV	**Preparation of solutions** Preparation of Molar solutions Preparation of normal solutions percentage solutions Preparation of different dilutions	
V	**Role of the Phlebotomy Technician** To develop broad understanding of the Role of PBT To identify Laboratory maintenance needs to be taken care by PBT To develop Understanding of Patient Comforts and Safety To develop understanding of Laboratory Test Results	

VI	**Specimens**: Types methods of collection, choice of specimens. Collection of blood (Capillary, venous and arterial blood) Collection of CSF & other body cavity fluids Urine collection Use of preservatives Anticoagulants Different types of vacutainers used in the laboratory	**1 Credit (15 Marks)**

PRACTICALS: **20 Marks (1 Credit)**

SL. NO.	EXPERIMENTS
I	Study of instruments, and appliances.
II	Cleaning and maintenance of glass wares.
III	Calculation and preparation of percentage solution.
IV	Calculation and preparation of Molar solution.
V	Calculation and preparation of Normality solution.
VI	Different types of blood collection. Collection and preservation of blood, serum and plasma.
VII	Estimation of blood sugar,
VIII	Blood urea,
IX	Creatinine,

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER-I

PAPER: MLT-VC-1036: CLINICAL PATHOLOGY (6 CREDITS)

Overview and key learning outcomes: In this paper the students have to know about various blood collection equipments, different types of blood sample collections, need to know about colour coded vacutainers, anticoagulants, further the students has to know basics about blood and other samples with suitable collections and various tests. The students have to learn about various laboratory hazards, safety and first-aid and personal hygene.

Total Marks: 100

UNIT	UNIT TITLE	Credits and Marks
I	Introduction to haematology. Collection of blood sample (capillary, venous and arterial blood) Different equipment used for blood sample collection. Interpretation of test request form. Correct method of preparation of an appropriate site for obtaining blood samples. Different types of vacutainer and order of blood draw.	**1 Credit (15 Marks)**
II	**Blood** Normal constituents of blood, their structure and function (Haemoglobin, RBC, WBC and platelets). **Anaemia**: Classifications – morphological and etiological. Effects of anaemia on body. Haematocrit Absolute Values (MCV, MCH & MCHC) RBC, WBC and Platelets count, composition of diluting fluids.	**1 Credit (15 Marks)**
III	**Haemostasis** Definition, normal haemostasis, Role of blood vassel, platelets and plasma proteins in haemostasis. Cotting factors, mechanism of clotting, Disorders of coagulation system.	**1 Credit (15 Marks)**
IV	**Clinical Pathology** Urine examination – Collection and Preservation of urine. Physical, chemical, microscopic examination of urine. Examination of different types of body fluids (pleural fluid, synovial fluid, ascitic fluid, cerebrospinal fluid, pericardial fluid and semen) Sputum examination Examination of faeces.	

V	**Introduction to Immuno-haematology** History of blood group Important types and principle of blood group systems methods Blood groups and Rh types, cross matching Universal donor and recipient concepts.	**1 Credit (15 Marks)**
VI	**Personnel Hygiene** ○ To develop understanding of the concept of Healthy Living ○ To develop understanding & procedures of Hand Hygiene ○ To be equipped with Techniques of Use of PPE	
VII	**Safety & First Aid** ○ To develop understanding and precautions to ensure Patient's Safety ○ To develop basic understanding and precautions to ensure sample preservation while transporting. ○ Describe common emergency conditions and what to do in medical emergencies. ○ Describe basics of first aid. ○ To develop understanding and precautions to ensure self-safety ○ Different types of Laboratory Hazards.	

PRCATICALS: **20 Marks (1 Credit)**

SL. NO.	PRACTICALS
I	Collection of Blood (capillary blood and Venous blood) using correct techniques
II	Haemoglobin Estimation (Sahli's Method and Cyanmethaemoglobin method)
III	Haematocrit (PCV)
IV	Erythrocyte Sedimentation Rate (ESR)
V	Bleeding Time(BT), Clotting Time(CT)
VI	Urine R/E Physical examination Chemical Examination o Test for sugar o Test for Proteins o Test for ketone bodies o Test for bile pigments o Test for Urobillinogen o Test for bile salts o Test for occult blood Microscopic Examination of Urine.
VIII	Blood grouping and Rh typing (Slide method and tube method)

INTERNAL ASSESSMENT **20 Marks (1 Credits)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER-II

PAPER: MLT-VC-2016: MICROBIOLOGY - I (6 CREDITS)

Overview and key learning outcomes: In this paper the student will have basic knowledge about various microorganisms like bacteria and its growth & nutrition, virus, parasites and identify bacteria, preparation of culture medium to grow bacteria. Further the students will be able to perform various sterilization methods, they will understand hospital born disease and its prevention and control.

Total Marks: 100

UNIT	UNIT TITLE	Credits and Marks
I	**Introduction to Microbiology** The history and scope of microbiology, characterization, classification of Micro-organisms. **Morphology of bacteria** Size, shape, structure of bacteria. Gram's characteristics of bacteria. Gram's staining Acid fast staining	**1 Credit (15 Marks)**
II	**Growth and Nutrition:** Nutrition requirements of bacteria, Growth and multiplications of bacteria Different types of culture media Use of culture media in diagnostic bacteriology. Methods of bacterial culture: Streak culture, lawn culture, stroke culture, stab culture, pour-plate culture, shake culture and liquid culture.	
III	**Sterilization and Disinfection** Definition Methods of sterilization and disinfection. Frequently used terms Anti septic and disinfectants Principles and use of equipments of sterilization namely Hot air Oven, Autoclave. Pasteurization.	**1 Credit (15 Marks)**

IV	**Systematic Bacteriology** Morphology, cultivation, disease caused, pathogenicity laboratory diagnosis including specimen collection of the following bacteria Streptococci, E. Coli, Clostridium and Mycobacterium.	**1 Credit (15 Marks)**
V	**Parasitology** Morphology, life cycle and laboratory diagnosis of E histolytica, B. coli, Plasmodium vivax, Plasmodium falciparum	
VI	1. Virology General properties of virus, diseased caused, lab diagnosis and presentation of following viruses. Hepatitis, HIV, rabies and poliomyelitis.	**1 Credit (15 Marks)**
VII	Infection control and prevention o Understand practices to curb infection o Understand hospital borne infections and causative agents o Investigation, preventions and control of hospital infections o Understand prevention and treatment of needle stick injury o Understand management of blood and body substance spills in the health care setting.	

PRACTICALS: **20 Marks (1 Credit)**

SL. NO.	EXPERIMENT
I	Demonstration and sterilization of equipments – hot air oven, autoclave, bacterial filters.
II	Demonstrations of commonly used culture media, nutrient broth, nutrient agar, blood agar, chocolate agar, Maconcy medium, L J media, Robertson cooked meat media,
III	Grams Stain
IV	Acid fast staining
V	Demonstration of common serological tests – WIDAL, VRDL, ELISA.

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER-II

PAPER: MLT-VC-2026: BIOCHEMISTRY - II (6 CREDITS)

Overview and key learning outcomes: In this paper the students will be able to understand basics about biochemistry of carbohydrates, lipids, vitamins, enzymes. Further they will be able to learn code of conduct for medical laboratory. The students will have to perform various blood and urine tests.

Total Marks: 100

UNIT	TOPICS	Credits and Marks
I	**Basic Sensitization to Biochemistry and Clinical Biochemistry** o Elementary knowledge of inorganic chemistry o Elementary knowledge of organic chemistry o Elementary knowledge of Physical Chemistry o Elementary knowledge of analytical chemistry	**1 Credit (15 Marks)**
II	Blood chemistry Urine chemistry	
III	**Carbohydrates:** Classification, Isomerism, Monosaccharides, Important chemical reaction of monosaccharides, Oligosaccharides, Polysaccharides, Glycoprotein, Mucopolysaccharides, Qualitative test for identification of carbohydrates.	
IV	**Introduction to metabolism** Catabolism and anabolism Types of metabolic reactions. Metabolism of carbohydrate and disorders of carbohydrate metabolism.	**1 Credit (15 Marks)**
V	**Lipids:** Classification, Simple lipids, Compound lipids, Glycolipids, Lipoproteins, Derived Lipids, Saturated fatty acids, Unsaturated fatty acid, Plasma Proteins, Lipoproteins, Essential fatty acid, Steroids, Important tests	
VII	**Vitamins:** Definition, classification, Sources, functions, deficiency, requirements.	**1 Credit (15 Marks)**
VIII	Biophysics: surface tension, osmolarity and viscosity.	
IX	Enzymes: Introduction, activation energy, classification, activity, specificity kinetics V max, km, Michaelis Menten equation.	**1 Credit**
X	MPNB: Urea, uric acid, creatinine of these importance.	

XI	Sensitization on current best practices in laboratory o Code of conduct for medical laboratory o Elementary knowledge on Good Clinical Laboratory Practices (GCLP) of WHO o Elementary Knowledge of laboratory safety guidance of OSHA (Occupational Safety and Health Administration), U.S. Department of Labour	**(15 Marks)**

PRACTICALS: **20 Marks (1 Credit)**

SL. NO.	EXPERIMENT
I	Estimation of blood sugar
II	Quantitative test for urine glucose and GTT.
III	Qualitative screening test for normal and abnormal urine sample.
IV	Biochemical Tests for Urine Test for sugar Test for proteins Test for ketones Test for bile pigments and urobillinogen Test for bile salts
V	Estimation of non protein nitrogenous compounds of blood: blood urea, creatinine, creatinine clearance test (CCT).

INTERNAL ASSESSMENT **20 Marks (1 Credits)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

. SEMESTER-II

PAPER: MLT-VC-2036: PATHOLOGY – II (6 CREDITS)

Overview and key learning outcomes: In this paper the students will be able to understand basics about the production of various blood cells, haemostasis and coagulation and related tests, slide preparation for blood and bone marrow for normal and abnormal cells. Further the students have to know various healthcare waste, safe handling and management of waste.

Total Marks: 100

UNIT	TOPICS	Credits and Marks
I	**Haematology** Haemopoiesis, stem cell, formed elements and their functions. Haematopoiesis in details (erythropoiesis, granulopoiesis, monocyte macrophage series, thrombopoiesis) Absolute eosinophil count Reticulocyte count. Preparation of staining of blood film for morphology of red cells and differential cell counts.	**1 Credit (15 Marks)**
II	**Haemostasis and Coagulation** a) Normal haemostasis, mechanism of blood coagulation and normal fibrinolytic system. b) Investigation of haemostatic mechanism – BT, CT, Whole blood coagulation time test, PT, APTT. c) Assay of clotting factors. d) Test for fibrinolytic activity – Euglobin, clot lysis test and FDP. e) Platelet function test.	**1 Credit (15 Marks)**
II	**Special haematological tests** a) Sickling test b) Osmotic fragility test c) Investigation of G6PD deficiency. d) Plasma haptoglobin and demonstration of hemosiderinin urine. e) Test for autoimmune haemolytic anaemia. Measurement of abnormal Hb pigments.	**1 Credit (15 Marks)**
IV	**Bone marrow biopsy Study** a) Needle aspiration and surgical biopsy techniques. b) Preparation of smear and staining	

V	**Histopathology** Introduction to histopathology Different branches of histopathology	**1 Credit (15 Marks)**
VI	**Cytology and Cytopathology** Introduction : Definition of cytology, Cells & tissues, Normal tissues Classification of cytology- Exfoliative and interventional cytology, Role of Cytology.	
VII	**Bio Medical Waste Management** ○ To gain understanding of importance of proper and safe disposal of bio-medical waste & treatment. ○ To gain understanding of categories of biomedical waste. ○ To learn about disposal of bio-medical waste colour coding, types of containers, transportation of waste, etc. ○ To gain broad understanding of standards for bio-medical waste disposal ○ To gain broad understanding of means of biomedical waste treatment.	

PRACTICALS: **20 Marks (1 Credits)**

SL. NO.	EXPERIMENTS
I	Red blood cell count.
II	Total white blood cell count.(TLC)
III	Platelet count.
IV	Blood smear preparation (PBF) and staining and Differential leucocyte count (DLC)
V	Calculation of red cell indices (MCV, MCH & MCHC)
VI	Determination of BT, CT, Whole blood clotting time, Clot retraction.
VII	Determination of PT and PTT

INTERNAL ASSESSMENT **20 Marks (1 Credits)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

❖ **At the ends of first year students have to undergo hospital training for one month.**

SEMESTER - III

PAPER: MLT-VC-3016: MICROBIOLOGY – II (6 CREDITS)

Overview and key learning outcomes: In this paper the students will be able to understand about various bacteria & fungus and diseases caused by it and lab diagnosis. Further the students will learn about various staining techniques for bacterial cell wall, bacterial capsule, fungal staining etc.

Total Marks: 100

UNIT	TOPICS	Credits and Marks
I	Medical bacteriology ➢ Morphology, colony characteristics, pathogenisity and laboratory diagnosis of : • *Staphylococcus epidermis* • *Streptococcus pneumoniae* • *Vibrio cholera* • Pseudomonas Spp • *Corynobacterium diphtheriae* • *Klebsiella pneumonia* • *Shalmonella Spp* • Shigella • Meningococci • Proteus spp • Spirochetes: - *treponema pallidum* - Borrelia - Leptospira • Helicobacter pylori	**2 Credits (30 Marks)**
II	Medical mycology Introduction to mycology, Properties of fungi, different type of mycosis ➢ General properties, pathogenesis and laboratory diagnosis of: • Superficial mycosis: Malsezzia furfur, T. nigra, T.pidera • Subcutaneous mycosis: Mycetoma, Rhinosporidium, Sporotrichosis • Dermatophytes • Systemic mycosis: Histoplasmosis, Blastomycosis, Coccidiodosis, Paracoccidiodosis • Opportunistic mycosis Aspergillosis	**1 Credit (15 Marks)**

	Penicillosis Zygomycosis Pneumocystis Mycotoxins	
III	Staining techniques • Capsular staining (negative staining) • Metachromatic granule staining • Flagellar staining • Cellwall staining • Endospore staining (Schafer fulton method) • Lectophenol cotton blue staining for fungi • Hanging drop technique for motility.	**1 Credit (15 Marks)**

PRACTICALS **20 Marks (1 Credit)**

SL. NO.	EXPERIMENTS
I	Gram's staining
II	Fungal staining (LPCB)
III	Capsule staining
IV	Hanging drop preparation
V	Negative staining
VI	WIDAL, CRP, ASO

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER - III

PAPER: MLT-VC-3036: PATHOLOGY – III (6 CREDITS)

Overview and key learning outcomes: In this paper the students will know about haemoglobin and various types of anaemia, different types of blood cell counts, further they will learn about basics of histotechniques and body fluid analysis.

Total Marks: 100

UNIT	TOPICS	Credits and Marks
I	**Sample collection** Understand blood and collection of blood sample in detail **RBC, WBC platelets, reticulocytes**	**1 Credit (15 Marks)**
II	**Haemoglobins** - Definition. ➢ Method and synthesis ➢ Normal & abnormal ➢ HB variants ➢ Method of estimation ➢ Clinical importance	
III	**Anaemia** – Definition ➢ Morphology & Etiologic classification ➢ Microcytic Hypochromic anaemia a) Causes b) Types c) Lab investigation. d) Laboratory pictures e) Clinical importance ➢ Normocytic Hypochromic anaemia and Diamorphic anaemia ➢ As other types of anaemia in details (Iron deficiency anaemia, megaloblastic anaemia, Aplastic anaemia, pure red cell aplasia)	**2 Credits (30 Marks)**
IV	**Histopathology** o Introduction to histopathology o Introduction to Cells, Tissues, Outline of methodology o Receiving of specimen in the laboratory. o Various fixatives, mode of action, preparation and indication. o Grossing techniques o Tissue processing for paraffin sections. o Embedding or blocking o Section cutting o Mounting techniques – various mountants. o Maintenance of records and filing of the slides. o Use and care of microscopes. o Staining of tissues – H&E stain.	**1 Credit**

VI	**Analytical Laboratory Testing Process** o To gain broad understanding of chemicals/reagents useful in sample analysis o To gain broad understanding of maintaining record of inventory, test results, etc. o Able to inspect the availability of medical supplies or diagnostic kits	**(15 Marks)**

PRACTICALS **20 Marks (1 Credit)**

SL. NO	EXPERIMENTS
I	Differential WBC count
II	Reticulocyte count
III	Absolute eosinophil count
IV	Study of Peripheral blood smear. Preparation of thin blood film , staining and study RBC morphology.
V	Osmotic fragility test
VII	Test for Sickle cell anaemia
VIII	Examination of different types of body fluids (CSF, Semen, Pleural fluid etc) Physical, Chemical and Cell count
IX	**Histopathology** o Labelling of specimen, Filling of forms o Receiving, entering and labelling and register o Grossing o Tissue Processing o Blocking and embedding o Section cutting o H&E staining

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER - III

PAPER: MLT-VC-3026: BIOCHEMISTRY – III (6 CREDITS)

Overview and key learning outcomes: In this paper the students will understand about the basics of Acid base balance, food and nutrition and its importance along with lipids, amino acids and protein metabolism.

Total Marks: 100

UNIT	TOPICS	Credits and Marks
I	○ Elementary knowledge of Acid Base Balance	**1 Credit (15 Marks)**
II	**Nutrition**	
III	**Lipids:** ○ Classification, Simple lipids, Compound lipids, Glycolipids, Lipoproteins, Derived Lipids, Saturated fatty acids, Unsaturated fatty acid, Plasma Proteins, Lipoproteins, Essential fatty acid, Steroids, Important tests	**1 Credit (15 Marks)**
IV	**Amino acids:** Common properties of amino acids, Structure of amino acids, Properties of amino acid	
V	**Proteins:** ○ Classification, Bonds relating to protein structure, Structure of protein, α helix, β Pleated sheet, Structure of protein related to biological function of protein, Denaturation of protein, Important tests of protein, Estimation of protein.	**1 Credit (15 Marks)**
VI	**Metabolism of Proteins:** Transamination, Oxidant, Deamination, Synthesis of urea, Test of urea in urine, Essential and non-essential amino acids, Creatine and Creatinine, Proteinuria	
VII	**Metabolism of Lipids** ○ β Oxidation of fatty acid, Biosynthesis of lipids, Prostaglandin, Cholesterol metabolism, Atherosclerosis, Essential fatty acids	**1 Credit (15 Marks)**

PRACTICALS: **20 Marks (1 Credit)**

SL. NO.	EXPERIMENT
I	Blood glucose
II	OGTT
III	Serum total protein, albumin globulin ratio
IV	Urine glucose
V	Serum lipids, Total cholesterol, HDL, LDL

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER - IV

PAPER: MLT-VC- 4016: MICROBIOLOGY – III (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn about various parasites and its types and the disease caused and various virus its transmission lab diagnosis etc. further the students will be able to identify different blood and stool parasites.

Total Marks: 100

UNIT	UNIT TITLE	Credits and Marks
I	**Introduction to Parasitology** Classification Frequently used terminology in parasitology Basic classification of Protozoa and Helminths (Basically medical importance)	**1 Credit (15 Marks)**
II	Describe the Morphology, Life-Cycle, Pathogenicity and Laboratory diagnosis of Protozoa o Entamoeba histolytica, o Balantidium coli, o Giardia, Toxoplasma, o Malaria, o Leishmania	**1 Credit (15 Marks)**
III	Describe the Morphology, Life-Cycle, Pathogenicity and Laboratory diagnosis of helminths and nematodes Nematodes- Ascaris, hookworm, Strongyloides, Trichuris,Trichinella, Dracunculus, Filarial	**1 Credit (15 Marks)**
IV	Describe the Classification and general properties of viruses.	**1 Credit (15 Marks)**
V	Describe the Morphology, pathogenicity and laboratory diagnosis of human viruses. • Hepatitis viruses • HIV • Rabies virus • Dangue virus • Herpes virus, • Adenoviruses • Influenza virus • H1N1 virus • Polio virus	

PRACTICALS **20 Marks (1 Credit)**

SL. NO.	EXPERIMENT
I	Saline preparation, Iodine Preparation of stool.
II	Saline concentration techniques for faecal parasite
III	Zinc sulphate floatation techniques
IV	Preparation and staining of thick blood smear for malaria parasite
V	Serological examination HbsAg, Tri Dot etc.

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER - IV

PAPER: MLT-VC- 4036: PATHOLOGY – IV (6 CREDITS)

Overview and key learning outcomes: In this paper the students will understand about blood groups, blood transfusion, different methods to identify blood groups, matching donor's blood with patient's blood, various screening procedures for donors. Further the students will be able to learn about cytotechniques.

Total Marks: 100

UNIT		Credits and Marks
I	**Sensitization to Blood Banking** Introduction to immuno-haematology ABO Blood group and Rh system in details Subgroups of A and B, Other blood groups and other blood group systems (Bombay group) Methodology to identify blood groups HLA antigens and their significance	**1 Credit (15 Marks)**
II	Principle of Blood transfusion: a) Blood donor selection b) Methods of bleeding donors c) Blood containers, anticoagulants and storage of blood d) Coomb's test and its significance e) Screening of blood for ineffective material f) Blood components, preparation & component therapy g) Autologous transfusion h) Transfusion reactions. i) Blood bank organization, standards, procedures, techniques and quality control	**2 Credit (30 Marks)**
III	**Cytopathology** o Brief introduction of cytology and cytopathology o Elementary knowledge of specimen collection and transportation o Elementary knowledge of precautions to be taken for gynaecological samples o Elementary knowledge of specimen collection, transportation and preservation of nongynaecological samples o Understand about fixation and fixative o Understand about fluid specimen o Describe the Papanicolaous stain	**1 Credit (15 Marks)**
IV	**Fine needle aspiration** o Understand the purpose of fine needle aspiration o Describe the procedure of fine needle aspiration.	

PRACTICALS: **20 Marks (1 Credit)**

SL. NO.	EXPERIMENTS
I	Preparation of 5% and 10% red blood cell suspension
II	ABO & Rh typing (Both slide and tube method)
III	Back typing or serum typing
IV	Cross matching (Major and Minor cross matching)
V	RhD antibody determination
VI	**Cytopathology** Sample receiving labelling and entering
VII	Preparation of Exfoliative cytological smears
VIII	Fixation – types and methods Wet and dry fix smear

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

SEMESTER - IV

PAPER: MLT-VC- 4026: BIOCHEMISTRY – IV (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn about hormone and its mechanism, different enzymes and elevated levels in various disease conditions, further the students will know about the functions of liver, kidney, heart, thyroid and tests to evaluate these organs.

Total Marks - 100

UNIT	TOPICS	Credits and Marks
I	**HORMONES:** General characteristics of hormone, Mechanism of action of hormone, Hypothalamic and pituitary hormones, Steroid hormones, Thyroid hormones, Pancreatic hormones.	**1 Credit (15 Marks)**
II	**CLINICAL ENZYMOLOGY:** Iso-enzymes, Lactate dehydrogenase, creatine kinase, aspartate amino amylase, isocitrate dehydrogenase., Enzymes as therapeutic agents, Enzymes used for diagnosis Immobilized enzyme	**1 Credit (15 Marks)**
III	**ORGAN FUNCTION TEST** **1. Liver function tests:** Role of Liver in metabolism, Tests for Liver Function, Serum bilirubin, Classification of jaundice, Bile acids and bile salts, Tests based on metabolic capacity of liver, Tests based on synthetic function **2. Renal function tests** Functions of kidney, formation of urine, Urea clearance tests, Endogenous creatine clearance tests, Tests for renal blood flow, Test based on tubular function, Water dilution tests **3. Gastric function tests** Test for determining gastric function, Examination of resting contents, Fractional gastric analysis, Histamine stimulation tests **4. Lipid Profile Test** **4. Thyroid function tests:** T3, T4 and TSH	**2 Credits (30 Marks)**

PRACTICALS **20 Marks (1 Credit)**

SL. NO.	EXPERIMENT
I	1. Liver function tests ➢ Bilirubin (total & direct indirect) ➢ SGOT ➢ SGPT
I	2. Renal function tests ➢ Urea ➢ Creatinine ➢ Uric acid
III	3. Lipid profile ➢ Cholesterol ➢ HDL ➢ Triglycerides ➢ LDL
IV	4. Pancreatic function tests ➢ Amylase ➢ LDH

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, mid term examinations, seminar/ presentations, attendance.

❖ **At the ends of second year students have to undergo hospital training for one month.**

SEMESTER-V

PAPER: MLT-VC- 5026: BIOCHEMISTRY – V (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn about water and mineral metabolism and associated diseases related to it, different inorganic ions and importance in our body, formation of kidney stone, concept of acid and base with related disease with acid base balance disturbances.

Total Marks - 100

UNIT	TOPICS	Credits and Marks
I	**WATER AND MINERAL METABOLISM:** Distribution of fluids in body, Water metabolism, Factor influencing the distribution of body water, Intake and loss of body water, Dehydration, Principal mineral elements, essential trace elements, Calcium and phosphorus metabolism, Magnesium metabolism, Iron, zinc, copper metabolism	**1 Credit (15 Marks)**
II	**Gastric Analysis**: Composition of gastric juice, concepts of free and bound acids, gastric acid secretion stimulation. **Inorganic ions**: Calcium metabolism, phosphate metabolism, sodium-potassium balance and trace element (Fe, CU)	**1 Credit (15 Marks)**
III	**Calculi**: Theory of formation and analysis, Renal clearance concentration and application of Phenolsulfonaphthalein.	**1 Credit (15 Marks)**
IV	**Acid**: Base balance and its disturbances.	
V	**Metabolism of proteins and amino acids**.	**1 Credit (15 Marks)**

PRACTICALS: **20 Marks (1 Credit)**

SL. NO	EXPERIMENTS
I	Serum electrolyte ➢ Bicarbonate ➢ Sodium ➢ Potassium ➢ Calcium ➢ Chlorine
II	Total protein, albumin, globulin and Ratio of A:G.

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, midterm examinations, seminar/ presentations, attendance.

SEMESTER-V

PAPER: MLT-VC- 5016: MICROBIOLOGY – V (6 CREDITS)

Overview and key learning outcomes: In this paper the students will understand about body defense system and types, vaccines and immunization, infection that can be transmitted from hospital, prevention and control of hospital infection. Further the students will have idea about various serological tests.

Total Marks – 100

UNIT	TOPICS	Credits and Marks
I	**Immunology** Definition, types of immunity, Immune response, immunoglobulin and its types.	**1 Credit (15 Marks)**
II	Hypersensitivity, autoimmune diseases	**1 Credit (15 Marks)**
III	Vaccines, Immunization schedule.	**1 Credit (15 Marks)**
IV	**Serological tests** (WIDAL,VDRL,ASO,CRP,RIA,RF & ELISA) Rapid test for HIV and Hbs Ag	
V	Hospital infection Causative agents, transmission methods, prevention and control hospital born infection.	**1 Credit (15 Marks)**

PRACTICALS: **20 Marks (1 Credits)**

SL. NO	EXPERIMENTS
I	WIDAL,VDRL,ASO,CRP,RIA,RF & ELISA
II	Rapid test for HIV and Hbs Ag
III	Mountoux test

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, midterm examinations, seminar/ presentations, attendance.

SEMESTER - V

PAPER: MLT-VC- 5036: PATHOLOGY – VI (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn about the tissue specimen, taking specimen for grossing, fix it with proper fixative, processing the tissue specimen to place the fixed tissue in the paraffin, taking tissue specimen for embedding, proper sectioning of the tissue and stain it with various staining solutions.

Total Marks – 100

UNIT	TOPICS	Credits and Marks
I	Introduction to Histopathology Introduction to Cells, Tissues, Outline of methodology **Specimen receiving, labelling and registration in the laboratory**. o Mention proper label with patient information and avoid cross contamination of the specimen. o Mention unique specimen identification number and type of specimen.	**1 Credit (15 Marks)**
II	**Fixatives** o Fixative definition o Classification, mode of action of various fixatives o Aim of fixation o Routinely used fixatives o Anatomically correct dissection. o Ratio of fixative and specimen. o Buffered fixatives o Preparation of various fixatives	
III	**Grossing techniques** o Specimen identification o Mention the batch date and name o Place the specimen in formalin as quickly as possible o Place the specimen in an appropriate size container so that formalin surrounds the tissue on all sides o Ensure that the surgical number on the requisition matches that on the specimen container, worksheet and cassettes	**1 Credit (15 Marks)**
IV	**Tissue processing for paraffin sections.** o Select appropriate process and reagents for processing o Monitor processor regularly during processing sequence to ensure that dehydration, clearing and infiltration process are complete o Ensure the tissue is infiltrated with the embedding agent o Post fixation treatment.	

V	**Embedding or blocking** o Check that temperature of wax is suitable for embedding process o Check that volume of wax is sufficient for uninterrupted embedding of processor load o Embed tissue in correct orientation o Allow block to solidify evenly according to wax requirements o Choose an appropriate mold **Section cutting** o Learn to trim the specimen o Learn to fix the microtome knife/blade to micotome o Learn to form serial section/ ribbons o Lean to place the tissue in tissue flotation bath for flattening the tissue Use of proper adhesive and avoid cross contamination of section	**1 Credit (15 Marks)**
VI	**Different types of microtome and microtome knives, honing and stropping** o Mounting techniques – various mountants. o Maintenance of records and filing of the slides. o Use and care of microscopes. o Staining of tissues – H&E stain.	
VII	**Staining**- Basic structure of a dye, Production of colour, Mechanism of staining, Metachromasia, Progressive and regressive staining, Mordant, Accentuators, Classification of dyes Preparation, Solvent, Technique of staining, Routine staining Haematoxylin & Eosin stains Preparation & compositions, Technique **Special stains** a) Connective tissue stains- Van Gieson's stain, Masson's trichrome stains, Gordon's and sweets methods, RNA stain -Fuelgen stain, b) Carbohydrates staining-PAS, Mucicarmine stain **Pigments and its stains**- Endogenous pigments. Eg : Haem pigments, Perl's Prussian blue, Haemozoin pigments, Haematoidin pigments, Bile pigments, Tyrosine pigments, Lipid pigments	**1 Credit (15 Marks)**
VIII	Frozen section and Cryostat section studies	

PRACTICALS: **20 Marks (1Credit)**

SL. NO	EXPERIMENTS
I	Instruments used in Histopathology Laboratory
II	Labelling of specimen, Filling of forms
III	Receiving, entering and labelling and register
IV	Slide demonstration of different types of cells
V	Common instruments for histopathology, cytopathology Lab.
VI	Fixative preparation, Preparations of graded alcohols
VII	Grossing, role of technicians
VIII	Tissue Processing,
IX	Preparation of blocking and section cutting
X	staining and mounting labelling
XI	Decalcification
XII	Special Stains
XIII	Preservation and museum technique

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, midterm examinations, seminar/ presentations, attendance.

SEMESTER - VI

PAPER: MLT-VC- 6026: BIOCHEMISTRY – VI (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn about basics of DNA & RNA, replication of DNA, genetic engineering, Metabolic disorders of amino acids, elevation of enzymes in disease condition, isoenzymes, techniques used in biochemistry, further the students will understand the basics of biostatistics.

Total Marks – 100

UNIT	TOPICS	Credits and Marks
I	Over view & replication, translation, transcription and genetic engineering.	**1 Credit (15 Marks)**
II	Metabolic disorders: Amino acids Proteins Inborn erros of metabolic disorders.	**1 Credit (15 Marks)**
III	Clinical enzymology.	**1 Credit (15 Marks)**
IV	Radio isotope techniques: Principle, definition of units, measurement of radiation standards, crystal counting, Resources and application.	
V	Immunoassy: Different method, principle and applications.	**1 Credit (15 Marks)**
VI	Biostatistics: Population mean, Correlation Coefficient, Standard deviation, Standard error.	

PRACTICALS: **20 Marks (1 Credit)**

UNIT	TOPICS
I	1. Specimen Collection: Urine, Blood, Gastric juice.
II	2. Enzymes: amylase (salivary and pancreatic), Alkaline Phosphatase, Acid Phosphatase, SGOT, SGPT, LDH and CPK- DEMONSTRATION ON AUTO ANALYZER.

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, midterm examinations, seminar/ presentations, attendance.

SEMESTER-VI

PAPER: MLT-VC- 6016: MICROBIOLOGY – VI (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn in details about various medically important bacteria, basics of molecular biology and different types of microscope including electron microscope.
Total Marks – 100

UNIT	TOPICS	Credits and Marks
I	**Systemic Bacteriology** **1.** Systemic Bacteriology- Classification, Morphology, Genotypic & Phenotypic characteristics, Pathogenesis, Disease Caused **Lab Diagnosis & Prophylaxis** o Pneomococcus o Listeria o Actinomyces o Nocardia o Neisseria o Enterobacteriaceae o Proteus o Pseudomonas o Haemophilus o Brucella o Pasturella o Bordetella o Campylobacter o Bacteroides o Fusobacterium	**2 Credits (30 Marks)**
II	**Mycobacteria** **i.** M. tuberculosis **ii.** M. laprae **iii.** Atypical Mycobacteria	
III	Molecular techniques in Diagnosis microbiology- PCR,DNA hybridization	**1 Credit (15 Marks)**
IV	Microscopy: ➢ Bright-field Microscopy. ➢ Dark field Microscopy. ➢ Phase contrast Microscopy. ➢ Fluorescence Microscopy. ➢ Electron Microscopy • Transmission electron Microscopy • Scanning electron Microscopy	

PRACTICALS: **20 Marks (1 Credit)**

SL. NO.	EXPERIMENTS
I	Culture Methods
II	Identification of bacterial culture Colony Characteristics Morphological Characteristics Motility Study Interpretation biochemical reactions
III	Introduction to biochemical reactions
IV	Antibiotic Sensitivity testing –Kirby Bauer method

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, midterm examinations, seminar/ presentations, attendance.

SEMESTER-VI

PAPER: MLT-VC- 6036: PATHOLOGY – VI (6 CREDITS)

Overview and key learning outcomes: In this paper the students will learn in details about cytopathology and various branches, different types of specimen used in cytopathology lab, different normal and abnormal cells, Fine needle aspiration cytology along with different fixation and staining.

Total Marks – 100

UNIT	TOPICS	Credits and Marks
I	Introduction : Definition of cytology, Cells & tissues, Normal tissues Classification of cytology- Exfoliative and interventional cytology, Role of Cytology, Nuclear criteria of inflammation & malignancy,	**1 Credit (15 Marks)**
II	Collection of specimen from female genital tract specimen for routine screening. ➢ Cervical smear ➢ Vaginal pool smear ➢ Lateral vaginal smear ➢ Combined (fast) smear ➢ Triple smear ➢ Endocervical and endometrial smear.	
III	Urinary cytology ➢ Collection of `urinary tract specimens ➢ Diagnostic utility of urinary cytology	**1 Credit (15 Marks)**
IV	Progressive changes of the cells i. Changes in inflammation ii. Dyskariotic Changes iii. Changes in malignancy	
V	Body cavity Fluids i. Effusions ii. Collection and processing of body cavity fluid specimens iii. Cyto-preparation and staining iv. Processing of clotted and Bloody specimen.	
VI	Fine Needle Aspiration Cytology ➢ Application of FNAC ➢ Advantages of FNAC ➢ General procedure of FNAC ➢ Limitation of FNAC ➢ Wet and Dry fixed smear, its difference	**1 Credit**

VII	Imprint cytology, Crush Smear cytology, Biopsy sediment cytology i. Cell block preparation ii. Cytological fixative and mailing Definition, iii. Types/classification, Aims & object iv. Materials for establishments of cytological lab	**(15 Marks)**
VIII	Staining : R/E stain types-Methods, Maintenance, Preparation of stain, Pap's stain Special stains- MGG, PAS, ZN, Mucicarmine etc. Mounting and Labelling	**1 Credit (15 Marks)**
IX	Establishments of lab- Manpower, Space, Ventilation, Light, Water, Working benches, Room arrangements, Reception of specimens, Instruments required	

PRACTICALS: **20 Marks (1 Credits)**

SL. NO.	EXPERIMENTS
I	Sample receiving labelling and entering
II	Preparation of Exfoliative cytological smears,
III	Fixation – types and methods, Fixatives preparations
IV	Preparation of smears in interventional cytology, Fixation and stains
V	Assist in FNAC
VI	Staining R/E - Preparation of stains Methods - MGG stain, PAP's Stain
VII	Determination of sex chromatin

INTERNAL ASSESSMENT **20 Marks (1 Credit)**

Submission of assignments on given topics, midterm examinations, seminar/ presentations, attendance.