

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

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**Master of Science in**  
**Medical Laboratory Technology (M.Sc. MLT)**  
**JUNE-2024**

**R. M.Sc. MLT. 1:** A candidate for the admission to M.Sc. (MLT) must have passed the B.Sc. degree Examination of the Sardar Patel University with Medical Laboratory Technology (MLT) / Microbiology / Biochemistry / Zoology / Botany / Bio Technology / Environmental Science / Genetics / Industrial Microbiology / Life Sciences / Bioinformatics OR an examination in any other university with 10+2+3 system recognized as equivalent to any of the above courses. The degree of Master of Science, a two-year course, would be through papers, practicals and dissertation work, wherever prescribed.

**R. M.Sc. MLT. 2:** The final examination for SEVEN theory papers would be conducted in two parts:

M.Sc. Part I: Three papers at the end of the first academic year.

M.Sc. Part II: Four papers at the end of second academic year.

However, practicals and grand viva, including viva for the dissertation work, will be held by the University at the end of two academic years.

**R. M.Sc. MLT. 3:** (a) Candidate will be examined in theory papers and practicals including viva for the dissertation work wherever prescribed. (b) For deciding the result of M.Sc. (MLT) examination, the ratio of Internal and External assessment will be 20:80. (c) For the purpose of internal assessment, the concerned department/s would conduct theory exam of respective papers and practical examinations at the end of each term.

**R. M.Sc. MLT. 4:** Candidate shall be required to attend at least 75% of the Lectures and Practical separately in each year.

**R. M.Sc. MLT. 5:** Every candidate shall maintain a regular record of his practical work / Journal, which will be checked by the teacher from time to time and duly certified by the head of department at the end of the semester. This Practical record / Journal will be given at least 10% weightage in the Internal as well as external practical exam.

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**R. M.Sc. MLT. 6:** (a) Every candidate shall carry out a dissertation work on the topic assigned to him/her by the head of the department under the guidance of a recognized/approved Post Graduate teacher of the concerned specialty. Selection of the subject for dissertation will be in consultation with respective guide and HOD. (b) The head of the department will monitor the distribution of the subjects among candidates in such a manner that different specialties of MLT such as clinical pathology, Hematology, Blood banking, Biochemistry, Microbiology etc. receive due consideration. (c) A candidate shall be considered eligible for the final Examination only if he/she submits the dissertation thesis in second year before final examination. (d) The dissertation work must be evaluated by at least one external examiners in order to conduct a dissertation.

**R. M.Sc. MLT. 7:** A candidate shall be deputed for a total of a minimum 3 weeks (to maximum 5 weeks) during the entire course, either at a stretch or in parts, to one or more such reputed Institute, The concerned department/Institute does not have any financial obligation, as such, for the deputation of candidate. All expenses will be born by the candidate.

**R. M.Sc. MLT. 9:** Standard of passing: The standard of passing the M.Sc. degree examination will be as under: (a) to pass the M.Sc. Degree examination, a candidate must obtain at least 45% marks (aggregate of external and internal) in each of the semester separately. (b) Award of class will be as per the other degree examinations of S.P. University.

**R. M.Sc. MLT. 10:** A candidate, who fails in any one or more of the theory papers or in practical examination, will be allowed to appear in those paper/s or practical, as the case may be, during the subsequent University examination held in Oct-Nov or in April-May; along with his/her Part II examination. (d) In case of repeat exam, in part or whole, original internal marks, calculated on the basis of multiple internal examinations during four terms, will only be considered.

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<b>Programme Outcome (PO)</b>	<ul style="list-style-type: none"> <li>• An ability to perform regular clinical laboratory procedures within the adequate quality control parameters.</li> <li>• The students also get to learn to analyse, test and examine laboratory samples in-which is used for the purpose providing the necessary medical assistance and care for the patients facing any sickness.</li> <li>• Demonstrate technical skills, social behaviour, and professional awareness incumbent upon a laboratory technician.</li> <li>• Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Biochemistry, Immunohematology, Cytopathology, Histopathology, Blood transfusion and Microbiology under the general supervision of a Clinical Laboratory Scientist or Pathologist</li> <li>• Provide Medical laboratory services in all types of clinical laboratories from Primary healthcare laboratory to Tertiary health care institution in the fields of Bacteriology, Immunology, Mycology, Parasitology and Virology.</li> </ul>
<b>Programme Specific Outcome (PSO) –</b>	<ul style="list-style-type: none"> <li>• Proficiently supervise and perform full range of clinical Biochemistry laboratory tests.</li> <li>• Entrepreneurship in Medical Laboratory Sciences</li> <li>• Core knowledge on Haematology, Cytology, Cytogenetics, Histopathology, Clinical pathology, Molecular biology, Blood banking and Immunopathology.</li> <li>• Be able to work as technician in laboratories attached to hospitals under the supervisions of senior officers like Biochemist, Microbiologist or Pathologist.</li> </ul>

<b>Standard of passing:</b>	<p>The standard of passing the M.Sc. degree examination will be as under:</p> <p>A. To pass the M.Sc. Degree examination, a candidate must obtain at least <b>45% marks</b> (aggregate of external and internal) in each of the SEVEN theory papers of Part I and part II as well as in practical <b>separately</b>.</p> <p>B. Award of class will be as per the other degree examinations of faculty of Medicine, S.P. University.</p>
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**PROGRAMME STRUCTURE**  
**M.Sc. - Medical Laboratory Technology**

**M.Sc. – MLT (Part-I)**

Course Code	Subject	Theory/ Practical	Duration of Examination (hours)	Component of Marks		Total
				External	Internal	
PME01M LT01	Clinical Pathology and Haematology	Theory	3 hours	80	20	100
PME01M LT02	General Biochemistry and Laboratory techniques	Theory	3 hours	80	20	100
PME01M LT03	Microbiology and Immunology	Theory	3 hours	80	20	100
<b>TOTAL</b>				<b>240</b>	<b>60</b>	<b>300</b>

**M.Sc. - Medical Laboratory Technology**

**M.Sc. – MLT (Part-II)**

Course Code	Subject	Theory/ Practical	Duration of Examination (hours)	Component of Marks		Total
				External	Internal	
PME02MLT 01	Medical Microbiology	Theory	3 hours	80	20	100
PME02MLT 02	Clinical Biochemistry & Molecular Diagnostics	Theory	3 hours	80	20	100
PME02MLT 03	Techniques in Histopathology and Cytology	Theory	3 hours	80	20	100
PME02MLT 04	Blood Banking & Serology	Theory	3 hours	80	20	100
PME02MLT 05	Practical – I (Pathology) Practical – II (Biochemistry) Practical – II (Microbiology)	Practical  Practical  Practical	3 hours  3 hours  3 hours (Two day)	240	60	100
PME02MLT 06	Dissertation/ Project	-	Thesis & Viva	50	-	50
<b>TOTAL</b>				<b>610</b>	<b>140</b>	<b>750</b>

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**M.Sc. - Medical Laboratory Technology**  
**M.Sc. – MLT (Part-I)**

Course Code	PME01MLT01		
Title of Subject	Clinical Pathology and Haematology	Total Hours/Week Tutorial Hours/Week	04 02
Course Objectives	<ul style="list-style-type: none"> <li>• Providing in-depth knowledge about the pathology and pathophysiology of hematological disorders.</li> <li>• Student enables the students to carry out routine clinical laboratory investigation (on samples i.e. urine, stool, sputum, semen, CSF &amp; Other body fluids etc.)</li> <li>• Students will learn the basic concepts of Haematology &amp; routine clinical investigations of Haematology laboratory</li> <li>• To provide brief knowledge of immunohematological diseases</li> </ul>		
Course Content			
Unit	Description		Weightage
1	<b>Fundamentals of different Organ Systems</b> , Cardiovascular System, Respiratory System, Digestive System, Urogenital System, Excretory System, Reproduction System, Endocrine System, Lymphatic System, Central & Peripheral nervous system		12%
2	<b>Formation of urine:</b> Method of Collection, Normal Constituents, Physical Examination, Chemical Examination, urine Analyzer. <b>Stool Examination</b> : Method of Collection Normal Constituents and appearance, Abnormal Constituents (Ova, Cyst) <b>Tutorial:</b> Automated Urine Analysis & Reagent Strip Method, Routine - Physical, Chemical & Microscopic Examination of stool.		12%
3	<b>C.S.F. Examination:</b> Physical Examination, Chemical Examination, Microscopy <b>Semen Analysis:</b> Collection, Examination, Special Tests, Total Sperm Count, Motility, <b>Sputum Examination:</b> Importance, Specimen collection, Physical examination, Microscopic examination <b>Tutorial:</b> Medico – legal significance of Semen examination & Demonstrating Cytologic examination of cerebrospinal fluid (CSF)		12%
4	<b>Estimation of PCV</b> - Macro & Micro Method, procedure filling the tube, centrifuging and reading, advantages of each - normal values and clinical significance, Estimation of Erythrocyte indices – calculation and importance MCV, MCH, MCHC, RDW, color index <b>Tutorial:</b> RBC indices of a complete blood count (CBC) and their interpretation,		13%
5	<b>Formation of Blood</b> , Erythropoiesis, Leucopoiesis, Thrombopoiesis, Collection of Blood, Anticoagulants, Red cell count – Haemocytometer, Methods and Calculation <b>WBC Count</b> – Methods Differential Leucocytes Count (DLC)-Morphology of White Cells, Normal Values Rananocostry Stains : Staining procedures, Counting Methods, Principle of staining <b>ESR:</b> introduction, factors affecting		13%

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	ESR, principles and methods of determining, ESR, increasing and decreasing conditions of ESR. <b>Tutorial:</b> RBC and WBC manual count, HEMOCYTOMETER	
<b>6</b>	<b>Haemoglobinometry:</b> hemoglobin - definition, function, structure, various methods of estimation - Sahli's, CMG, oxyhemoglobin, specific gravity method etc., Clinical significance of Hb estimation. <b>Anaemia:</b> Definition, classification, clinical features. Introduction, causes & lab. diagnosis of Iron deficiency anemia, Megaloblastic anemia, aplastic anemia, sickle cell anemia <b>Tutorial:</b> Different methods to measure Haemoglobin and Haemoglobinometry	13%
<b>7</b>	<b>Special Hematological tests:</b> Sickling tests, Osmotic fragility test, Determination HbF and HbA <sub>2</sub> , Hemoglobin Electrophoresis, Investigation of G6PD deficiency, Plasma Haptoglobin, Tests for Autoimmune hemolytic anemia, Measurement of abnormal Hb pigments, Blood Smear Examination: in Leukaemias, Haemoparasites in Blood, PBF in Malarial Parasite. <b>Tutorial:</b> Hemoglobin electrophoresis procedure, Peripheral smear for malaria, Demonstration of hemosiderin in urine	12%
<b>8</b>	<b>Blood Coagulation:</b> Collection of blood and anticoagulants used in coagulation studies, Investigation of hemostatic mechanism-BT, CT, whole blood coagulation time test, PT, PTT, Thrombin Time, Plasma Fibrinogen, FDP, D-Dimer, platelet count, protamine sulphate test, clot retraction test, <b>Bone Marrow:</b> Composition, Functions, Aspiration and Processing. Karyotyping: Chromosomal studies in hematological disorders, LE cell – definition, morphology causative agents. Various methods of demonstrating, LE cells. <b>Tutorial:</b> Bone marrow sample collection, basic laboratory procedures of karyotyping, demonstrating the L. E. cell	13%

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**M.Sc. – MLT (Part-I)**

Course Code	PME01MLT02		
<b>Title of Subject</b>	General Biochemistry and Laboratory Techniques	Total Hours/Week Tutorial Hours/Week	04 02
Course Objectives	<ul style="list-style-type: none"> <li>• Have gained sufficient knowledge on the chemistry of biomolecules in relation to human metabolism.</li> <li>• Student should know the structures and functions of biomolecules, their relations that form the basis of what we understand to be living organisms and know the experiment, research related to them.</li> <li>• Describe various techniques used in biochemistry.</li> </ul>		
Course Content			
<b>Unit</b>	<b>Description</b>	<b>Weightage</b>	
1	Introduction of Biochemistry, Chemical bonds & Interactions, Acid, Base, pH & buffer <b>Carbohydrates</b> Classification, Cyclic structure, physiologically important Monosaccharide derivatives: <i>Sugar Alcohols, Sugar Acids, Amino Sugars, Deoxy Sugars, Glycosides, Disaccharides</i> , Polysaccharides, Biomedical importance of Heteropolysaccharides, Digestion, absorption, transportation of Carbohydrate <b>Tutorial:</b> Types of pipettes, Calibration of pipettes, Cleaning of glassware, Test of various carbohydrate	12%	
2	Nucleic acids: Components of Nucleic Acids (Nucleotides, Nucleosides, Nitrogen bases, purines and pyrimidines and role of Nucleic acid), Physical and Chemical Structure of DNA, Plasmid DNA, Denaturation of DNA, Renaturation of DNA, Structure, Function and types of RNA <b>Tutorial:</b> Demonstration of chemical properties of nucleic acid.	12%	
3	Classification of lipid, Types of Fatty acid, Neutral Fats, Types of Phospholipid and its function, structure and function of Cholesterol, classification, chemistry and biosynthesis of prostaglandins (Prostaglandins, Prostacyclins, thromboxanes, Lipoxins) Digestion and absorption of dietary lipid <b>Tutorial:</b> Demonstration of various chemical properties of lipid, Basic and elementary concepts of chemistry and properties of lipids as applicable to the human body	12%	
4	Structure and Classification of <b>Amino acid</b> , Non-standard amino acid, Chemical properties of amino acid, <i>isoelectric point</i> (pI) of an amino acid, Peptide bond, structure of protein (Primary, Secondary Tertiary Structure), Precipitation of protein, quantitative determination of Proteins, Amino Acid Sequence Determination (Sanger's Method, dansyl chloride Method, Edman procedure)	13%	

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	<b>Tutorial:</b> Qualitative analysis of amino acid, To demonstrate the method for precipitation of protein	
<b>5</b>	General Properties and Classification of <b>enzyme</b> , Enzyme Specificity, Mechanism of action of enzyme, Role of Coenzymes, Prosthetic Groups, and Cofactors, Kinetics properties of enzyme (MM equation, Vmax, Km), Factors affecting enzyme activity, and Enzyme Inhibition (Reversible, irreversible, Suicide), Allosteric Regulation <b>Hormones:</b> Classification of hormones, organs of endocrine system their secretion and function, regulation of hormone secretion, General Mechanism of its action. <b>Tutorial:</b> To study the enzyme activity and its kinetics (Km and Vmax) of any one Enzyme	13%
<b>6</b>	<b>Mineral Metabolism</b> : Calcium and Phosphorus, Magnesium, Iron and Zinc <b>Vitamin Metabolism:</b> Deficiency disorders & biochemical functions of Fat-Soluble Vitamins (A, D, E, K) and Water-Soluble Vitamins – Thiamine, Riboflavin, Pyridoxine, Cobalamin, Folic Acid, Biotin, Ascorbic Acid <b>Water metabolism</b> (ICF, ECF, Role of Hormone in Homeostatic Controls), Regulation of osmolality in the body, Electrolytes, and Acid-Base Balance, Disorders of Acid-Base Balance	13%
<b>7</b>	<b>Colorimeter:</b> Principle and Instrumentation; Spectrophotometry: Ultraviolet, Mass spectrophotometry; Flame photometry, <b>Cytometry:</b> Types, Flow cytometry and its applications, <b>Fully &amp; Semi Automated Biochemistry Analyser</b> (Continuous Flow Analysers, Discrete Chemistry Analysers) Coagulometer, Blood Gas Analysers, <b>Centrifugation:</b> Principle; Preparative, Analytical <b>Tutorial:</b> Demonstration of Beer's Law and lambda max determination	12%
<b>8</b>	<b>Electrophoresis:</b> Immunoelectrophoresis, Isoelectric focusing, 2-D gel electrophoresis, Western Blotting, Southern Blotting, Northern Blotting, Capillary Electrophoresis, <b>Chromatography:</b> Affinity chromatography, Gel filtration, Gas Chromatography, HPLC, Ion exchange chromatography, <b>Nephelometry:</b> Basic principle, instrumentation, general technique and clinical applications, <b>Quality controls:</b> External and internal, filing of QC charts <b>Tutorial:</b> Demonstration of thin layer chromatography, Agarose gel electrophoresis and Western blotting techniques	13%



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**M.Sc. – MLT (Part-I)**

Course Code	PME01MLT03		
Title of Subject	Microbiology and Immunology	Total Hours/Week Tutorial Hours/Week	04 02
Course Objectives	<ul style="list-style-type: none"> <li>• The microbial structure, growth and development, methods and role of sterilization in the context of study of microbes are included.</li> <li>• Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology</li> <li>• This subject makes the students to know handling of instruments and sterilization techniques</li> <li>• To prepare the students in basic understanding of the autoimmunity and immunodeficiency.</li> </ul>		
Course Content			
Unit	Description		Weightage
1	<p><b>History:</b> Contributions of Louis Pasteur and Robert Koch in Medical Microbiology. General characteristics of prokaryotes &amp; eukaryotes, <b>Basic features and classification of bacteria</b>, General characteristics of bacteria, anatomy of bacteria, Morphological classification of bacteria, <b>Growth and Nutrition of Microbes:</b> General nutritional requirements of the bacteria, Classification of bacteria on the basis of their nutritional requirements, Normal growth cycle of bacteria (growth curve), Types of microbial cultures: Synchronous, Static, continuous culture.</p> <p><b>Tutorial:</b> Demonstrate the different morphological types of bacteria, demonstration to study the growth curve of bacteria</p>		12%
2	<p><b>Sterilization and Disinfection:</b> Physical methods- Sunlight, Drying, Heat, Filtration, Radiation; Chemical methods- Use of Alcohols, Aldehydes, Dyes, Halogens, phenols, Gases, Surface-Active agents, Metallic salts. Factors affecting sterilization and disinfection, Antiseptic, sanitizer, Germicide, Bactericide, Asepsis and Antimicrobial agent</p> <p><b>Tutorial:</b> - Biomedical waste management in a Medical Microbiology laboratory, method of sterilization by autoclave including its efficacy testing, Care &amp; maintenance of Laminar air flow, Demonstration of Antiseptics, Spirit, Cetrimide &amp; Povidone-Iodine.</p>		12%
3	<p><b>Culturing microorganism: Culture media:</b> composition, forms and types of culture media, Preparation and use of common media - Nutrient Agar, Mac Conkey Agar, Eosin Methylene Agar. CLED Agar, W B Agar, Kings Agar, MSA, PSA, Blood Agar, Chocolate agar. <b>Methods of Cultivation:</b> Broth, slant and Stab Enrichment technique. Preservation method, <b>Isolation and identification of bacteria:</b> Inoculation of microorganisms in to various types of culture media. Isolation of bacteria on nutrient agar plate. <b>Biochemical Test for Identification:</b> Sugar fermentation test, Litmus milk, Indole production Methyl Red test (MR), Voges – Proskauer test, Citrate utilisation, Nitrate reduction test, Production of ammonia, Urease test, Hydrogen sulphide production, Catalase production, Oxidase reaction</p> <p><b>Tutorial:-</b> Media preparation – details of ingredients, pH measurement, preparation of reagents, buffers, glass wares etc and quality control, Broth, slant preparation</p>		12%

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4	<p><b>Microscopy:</b> Magnification, numerical aperture, resolution and components of microscope. Dark ground illumination, care of microscope and common difficulties Micrometry. Types of microscopes: Principles &amp; Components, Light microscope, Dark field microscope, Fluorescent, Phase contrast, Electron microscope: Transmission/ Scanning, Bacterial Colony Counter</p> <p><b>Tutorial:-</b> demonstrate the working &amp; handling of Compound microscope,</p>	13%
5	<p><b>Preparation of microorganism for light microscopic examination:</b> Wet Mount, Hanging drop techniques, Principle and Procedure of Bacteriological stain- Simple staining, Negative staining, Gram stain, Acid fast staining, Albert's stain, Ziehl – Neelsen staining, Capsule staining, Flagella staining, Spore staining, cell wall, spore and metachromatic granules staining.</p> <p><b>Tutorial :</b> Preparation of smear, preparation of reagents &amp; stains, To demonstrate simple staining (Methylene blue)</p>	13%
6	<p><b>Collection, preservation, transport, processing and disposal of following clinical samples for culture:</b> Blood, Throat, Sputum, Pus, Urine, Stool, C.S.F</p> <p>Introduction, mechanism of action, classification and uses, <b>Bacterial Genetics:</b> Structure and replication of bacterial DNA plasmids, Mutation, Transfer of genetic material, Recombinant DNA Technology, <b>Antibiotic susceptibility testing in bacteriology</b>, Culture medium used for Antibiotic susceptibility testing, Automation in Microbiology and antibiotic Sensitivity test, Automation (BACTEK &amp; VITEK) Nucleic acid testing methods.</p> <p><b>Tutorial:</b> Demonstration of Collection of specimens for Microbiological investigations such as Blood, Urine, Throat swab, Rectal swab, Stool, Pus (swabs), OT and other specimens</p>	12%
7	<p><b>Classification of immunity:</b> Innate immunity, Acquired immunity, Active &amp; Passive immunity, Cell mediated immunity, Humoral immunity, <b>Antigens:</b> Definition, Characteristics ,Properties of antigen, Classification of antigens <b>Antibodies/ Immunoglobulins</b>, -Structure &amp; Types of immunoglobulins, <b>Major Histocompatibility Complex</b>, Complements, Alternative, Classical, Lectin, and Membrane Attack Pathways, Cytokines</p> <p><b>Tutorial –</b> Demonstrate the separation of globulin fraction from serum by SDS-PAGE,</p>	12%
8	<p><b>HYPERSENSITIVITY:</b> Introduction and classification of Hypersensitivity, Immediate &amp; delayed Hypersensitivity, Anaphylactic reaction, Tuberculin skin test <b>Autoimmunity</b> – Basic concept, Immuno-prophylaxis &amp; Immunization schedule, Vaccines-classification &amp; uses, Vaccination Schedule in India, <b>Immunodeficiency:</b> Immunological basis of Primary and secondary Immunodeficiency Diseases</p> <p><b>Tutorial:-</b> Demonstration of Vaccine Administration Procedures for Health Care Professionals</p>	13%

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**M.Sc. - Medical Laboratory Technology**  
**M.Sc. – MLT (Part-II)**

Course Code	PME02MLT01	
Title of Subject	Medical Microbiology	Total Hours/Week
Course Objectives	<ul style="list-style-type: none"> <li>• This part is designed to study the details of systemic bacteriology including its morphology, species, lab diagnosis, isolation and identification.</li> <li>• The students will learn the morphology cultural characteristics, biochemical characteristics &amp; laboratory diagnosis of various bacteria</li> <li>• The students should be able to identify common pathogenic viral and fungal agents and the diseases that they cause, their general and specific mechanisms.</li> <li>• Proficiently supervise and perform full range of clinical laboratory investigations related to Medical Microbiology</li> </ul>	04
Course Content		
Unit	Description	Weightage
1	<b>Systematic bacteriology I:</b> Morphology, Cultural Characteristics, Antigenic structures, Pathogenesis (in brief) Laboratory Diagnosis of following bacteria: <i>Staphylococci, streptococci, Pneumococci, Gonococci, Meningococci, Neisseria, Spirochaetes, Chlamydiae, Rickettsiae, Mycoplasma, Bordetella, Brucella, Lactobacillus, Micrococcus, Helicobacter, Campylobacter &amp; Spirillum</i>	12%
2	<b>Systematic bacteriology II:</b> Morphology, Cultural Characteristics, Antigenic structures, Pathogenesis, Laboratory Diagnosis of following bacteria: <i>Corynebacterium, Bacillus, Clostridium, Nonsporing anaerobes, Enterobacteriaceae, E.Coli, Klebsiella, Salmonella, Shigella, Proteus, Vibrio, Pseudomonas, Mycobacterium (M. tuberculosis, M. Leprae)</i>	12%
3	<b>Diagnostic virology I:</b> Classification of viruses, General properties of virus, Virus host interaction, The genetics of viruses, Virus replication, The pathogenicity of viruses, Epidemiology of viral infections, Bacteriophages. Lab diagnosis of viruses including collection, transport, isolation: DNA virus: <i>Herpes viruses, Adenoviruses Pox,</i>	12%
4	<b>Diagnostic virology II:</b> Diseases caused by different Virus and mode of infection: <i>Rubella virus, Influenza viruses, Polio, Hepatitis viruses, Rabies virus, Human immunodeficiency viruses, Corona viruses. Dengue, Oncogenic viruses, Viral neutralization tests, Viral haemagglutination tests, serological tests for viral infections</i>	13%

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<b>5</b>	<b>Parasitology</b> : General Introduction, life cycle, mode of transmission, pathogenicity, and lab diagnosis of various <b>Protozoa</b> : <i>Entamoeba Hisolytica, Entamoeba coli, Giardia lamblia, Trichomonas Vaginalios Leishmania donovani, Plasmodium, Trypanosoma, Toxoplasma Trichuris, Strongyloides, Ancylostoma, Ascaris, Enterobius (intestinal nematode)</i> <b>Helminths</b> : <i>Taenia solium, Taenia sagnata, Hymenolepis nana, Strongyloides, Echinococcus granulosus</i>	13%
<b>6</b>	<b>Medical Mycology</b> : Morphology, Classification and reproduction in fungi. Host reactions to fungi, Diseases caused and lab diagnosis of:- medical importance including <i>Candida, Cryptococcus, Malassezia, Trichosporon. Geotrichum. Saccharomyces, Mycelial fungi of medical importance including Aspergillus, Zygomycetes. Fungi causing mycetoma, keratomycosis &amp; otomycosis.</i>	13%
<b>7</b>	<b>Clinical Microbiology</b> : Normal microbial flora of human body, Collection and transport of specimen Bacterimia Pyaemia, Septicemia, Pyrexia of unknown origin (P.U.O) Meningitis, Respiratory Infection (Sore throat pneumonic, pulmonary Tuberculosis), Nosocomial Infections, Opportunistic Infection, Urinary tract infections, Sexually transmitted diseases, Diarrhoeal diseases & food poisoning	12%
<b>8</b>	<b>Antimicrobial resistance</b> and Mechanism of AMR, multidrug efflux pumps, extended spectrum $\beta$ -lactamases (ESBL), X-MDR M. tuberculosis, methacillin-resistant <i>S. aureus</i> (MRSA) Antibiotic Sensitivity Test: Introduction & use of antibiotic sensitivity test; Role of antibiotic sensitivity test; Components of antibiotic sensitivity test; Types of antibiotic sensitivity test (Diffusion and Dilution method of antibiotic susceptibility testing).	13%

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**M.Sc. – MLT (Part-II)**

Course Code	<b>PME02MLT02</b>		
Title of Subject	<b>Clinical Biochemistry &amp; Molecular Diagnostics</b>	Total Hours/Week	04
Course Objectives	<ul style="list-style-type: none"> <li>• Students will understand the chemistry, function, and biological importance of carbohydrates, proteins, lipids, nucleic acids, enzymes, vitamins and minerals.</li> <li>• Student acquired Knowledge in Recent advances in clinical biochemistry</li> <li>• Proficiently supervise and perform full range of clinical Biochemistry laboratory tests and advanced level of Molecular diagnosis.</li> </ul>		
Course Content			
Unit	Description	Weightage	
1	<b>Metabolism of Carbohydrates and its disorder:</b> Glycolysis, TCA cycle, Gluconeogenesis (in brief), HMP Pathway, Hormonal regulation of blood sugar level, Major Carbohydrate metabolic disorder: Diabetes mellitus, types, diagnosis, GTT, HbA1c, Diabetic complication, Glycogen storage diseases, deficiency of glucose-6-phosphate dehydrogenase, Hypoglycemia.	12%	
2	<b>Protein metabolism:</b> Transamination, Deamination, Decarboxylation of amino acid, Urea cycle and its disorders, Inborn error of Protein metabolism with its diagnosis: Phenylketonuria, alkaptonuria, Maple syrup urine disease, homocystinuria, albinism, Metabolism of Creatine, Metabolic disorder of nucleotides: gout, Lesch-Nyhan disease	12%	
3	<b>Metabolism of lipids:</b> Beta-oxidation of fatty acid, Ketone bodies synthesis and degradation, Ketosis and its diagnosis, Cholesterol metabolism and its significance, Lipoprotein metabolism in health and disease, Metabolism of Chylomicrons, VLDL, IDL, LDL and HDL, Measurement of Lipid Profile, hyperlipoproteinemia, Abetalipoproteinemia, Fatty liver, Arteriosclerosis and Obesity	12%	
4	<b>Clinical Enzymology:</b> Introduction and Basic Concepts of Isoenzymes, Types of Enzyme assays- Endpoint and Kinetic, Diagnostic value of serum enzymes - Creatinine kinase, alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc <b>Clinical Nutrition:</b> Calorific value of foods – Basal metabolic rate (BMR) – respiratory quotient (RQ) Specific dynamic action (SDA), Body Mass Index (BMI), GI index, Balanced diet, Functional foods, Protein Calorie malnutrition (Marasmus & Kwashiorkor)	13%	

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

<b>5</b>	<p><b>Organ Function test</b> : Liver function tests, Renal function tests, Pancreatic function tests, Thyroid function tests, Cardiac function test, Gastric Analysis, Composition of gastric juice, concepts of free and bound acid, Fractional Test Meal, Mention Point of care testing (POCT)</p> <p><b>Estimation using ELISA &amp; Chemiluminiscent analyzer:</b> T3, T4, TSH, FSH, LH, hCG, Cortisol, Progesterone, Testosterone</p>	13%
<b>6</b>	<p><b>TUMOR &amp; CANCER MARKERS:</b> Carcinogens, Malignant transformation of cells and role of oncogenes, Tumor suppressor genes, cancer causing viruses, Tumour Markers- Blood group antigen (CA 19-9, CA-125), Bladder tumor antigen, Carcino embryonic antigen (CEA), Alpha feto protein (AFP), Prostatic acid phosphatase (PAP), Prostate specific antigens (PSA), Beta hCG</p> <p><b>Forensic analysis</b> : Laboratory methods of determination alcoholic strength, Narco Analysis, Anti-doping test</p>	13%
<b>7</b>	<p><b>DNA Replication, Transcription</b> in Eukaryotes in brief, Polyadenylation and capping, RNA interference,</p> <p><b>Translation:</b> Mechanisms of initiation, elongation and termination of polypeptides in eukaryotes.</p> <p>Isolation and quantification of DNA and RNA, Types of Gene Mutations, methods used to detect point mutations</p> <p><b>Recombinant DNA technology</b>, Role of recombinant DNA technology as diagnostic tool. Introduction to generation of genomic and cDNA libraries</p>	12%
<b>8</b>	<p>Gene amplification through <b>PCR</b> and Types: Principle, methodology, primer designing, factors affecting PCR, advantages, limitations</p> <p>Variants of PCR: Reverse Transcriptase PCR, Real Time PCR</p> <p>Methodology and application of <b>DNA fingerprinting methods</b> (RFLP with probe introduction, RAPD, AFLP, SSR, SCAR, DGGE). Fluorescence In Situ Hybridization (FISH)</p> <p><b>Omics in Diagnostics:</b> Role of transcriptomic, proteomic, and metabolomics profiles as diagnostic markers.</p>	13%

**M.Sc. – MLT (Part-II)**

Course Code	<b>PME02MLT03</b>		
Title of Subject	<b>Techniques in Histopathology and Cytology</b>	Total Hours/Week	04
Course Objectives	<ul style="list-style-type: none"> <li>• Understanding the concept of histotechnology; Basic concepts about routine methods of examination of tissues Collection.</li> <li>• Perform routine laboratory procedures encompassing all major areas of the histology laboratory.</li> <li>• Understand the principles of Microtomy.</li> <li>• To learn about histopathological and cytological process in detail</li> <li>• Have knowledge on automation and quality control in histopathology and cytology</li> </ul>		

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

Course Content		
Unit	Description	Weightage
1	<b>Basics of Histology and Instrumentation:</b> • General introduction to Histological equipment and instruments, their uses, constructions, • maintenance and repair - Organisation of Histology Laboratory. <b>Preparation of museum specimen :</b> Care of Museum specimen , Preparation of fixatives and mounting solutions, Mounting and after care of mounted specimen, Cataloguing of museum specimen	12%
2	<b>Collections of specimen and biopsy:</b> • Reception and recording of tissue specimen - Biopsy, types of biopsy; <b>Tissue processing:</b> Collection of specimen, Labelling and fixation (Simple Fixative and Cytological Fixative (ii) Micro Anatomical Fixative), Mounting, Dehydration, Clearing, Impregnation , Embedding, Paraffin block making, Decalcification of Bone, Routine Paraffin staining, Automated tissue processor - components, working & precautions during use	12%
3	<b>Microtomes</b> and its types, microtome knives – sharpening of knife, Microtome use – Honing, Stropping, Techniques of section cutting, Mounting of sections. <b>Frozen Technique</b> Introduction - Frozen Section – Overview - Use of Freezing Microtome – Fixation - Freezing Microtome - Fixing sections on slides - Staining of frozen sections (rapid staining) - Advantages and disadvantages - Frozen Sections Using Cryostat – Uses - The Cryostat	12%
4	<b>Staining:</b> Dyes and their properties , Theory of staining , Staining technique with haematoxylin and eosin., Mounting of sections, <b>Common special stains –</b> , Routine H & E, Meason Trichrome , Men – Geison, Reticulin, PAS, PAP stain, Fe, Lipid, Stains for AFB, Mucicamine, Vencos for calcium, Special staining, Decalcification : Fixation, Decalcification, Detection of end point, Neutralization and processing.	13%
5	<b>Automation in histopathology:</b> • Tissue processing. • Staining. • Microtomy and tissue Embedding. • Biomedical waste management in histopathology <b>Autopsy</b> - Aims & methods of performing, Autopsy cleaning, suturing and retaining the body. Cleaning autopsy instruments, tables and rooms, preservation of organs. Necrosis (Kidney and Brain), Amyloidosis (Kidney and Liver), Gangrene Foot, Chronic venous congestion (Liver and Lung)	13%
6	<b>Basic Cytology:</b> • Basic Structure of mammalian cell, Benign and malignant cell pathology • Benign Pathological processes affecting the cell: • General introduction to tumours and morphological characters of cancer cells	13%

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

	<b>Instruments in Cytology</b> , Types of specimens, methods of collection & preparation of cell block, Different fixatives and methods of fixation: Papanicolaou's stain- principle , preparation and staining techniques, May Grunwald Giemsa stain, H & E stain	
<b>7</b>	<b>Exfoliative Cytology and Fine needle aspiration cytology:</b> Types of specimens and preservation. Preparation and fixation of smears, Papanicolaous staining technique/MCC staining/HE staining/ Sex chromatin staining, Nuscum Techniques, Reception of specimen, Preparation of fixation, Preservation Fine needle aspiration cytology (FNAC), Mass screening methods for early detection of cancer	12%
<b>8</b>	<b>Diagnostic cytology:</b> Introduction, Types of specimens, Processing, Fixation, Staining, Demonstration of sex chromatin, To perform Guard's staining for demonstration sex chromatin (Barr bodies on a buccal smear), Amniotic fluid study. Sickle Cell Preparation, Bone Marrow Smears Preparation & Staining Liquid based Cytology : Principle and Preparation , Quality control in Cytopathology	13%

**M.Sc. – MLT (Part-II)**

Course Code	<b>PME02MLT04</b>		
Title of Subject	<b>Blood and Stem cell Banking</b>	Total Hours/Week	04
Course Objectives	<ul style="list-style-type: none"> <li>• To understand the basic principle of blood banking.</li> <li>• Perform and interpret commonly utilized procedures in the blood bank laboratory.</li> <li>• Recognize normal and abnormal test results and correlate these data with appropriate pathologic conditions to accurately advise health care providers.</li> <li>• To be able to demonstrate auto mentation technique used in blood bank.</li> <li>• Student familiarize with stem cell technology and tissue banking.</li> </ul>		
Course Content			
Unit	Description		Weightage
1	<b>Basic principle in blood banking:</b> Blood bank organisation, Planning and documentation, NACO Blood bank policy, National blood policy, Indian Red Cross Society, DGHS and blood transfusion services. Anticoagulant use in blood bank, Instruments, equipment's and Record maintenance in blood bank • List of instruments and their uses, general care and protocol of use, quality control.		12%
2	<b>Phlebotomy:</b> Introduction of phlebotomy, syringe & needles. selection of veins, use of antiseptics, procedure of venipuncture for collection of blood, <b>ABO, Rh Blood Group:</b> Introduction, Human blood group antigens, ABO blood group system and incompatibility, Rh blood group system and incompatibility, Technique of grouping and cross matching , Commb's test, Direct, Indirect		



**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

3	<p><b>Blood Donation</b>  Introduction -Blood donor requirements - Criteria for selection &amp; rejection,  <b>Testing Donor Blood</b> - Screening donor's blood for infectious agents - HIV, HCV, HBV, Trepanoma palladium, Plasmodium, HTLV-Bacterially contaminated Blood.  <b>Blood Collection:</b> Blood Transfusion Procedure, Selection and screening of donor, Various anticoagulants, Sotrage of Blood, Changes in Blood on storage, blood bags, its Labelling, Cell separator and transfusion of various components of blood like Plasma and Platelet Separation, Blood bank organization donor motivation and auditing blood bank</p>	12%
4	<p><b>Storage of Blood component,</b> Physical and Biochemical changes of Storage Blood, General blood picture, estimation of iron, TIBC, Transferrin, Ferritin, Plasma, haemoglobin, Vit.B12, Folic acid, FIGLU test, Schiling test, Parietal cell antibodies,G-6-PD, Osmotic fragility test, Heinz bodies, Perls Prussian staining, Platelet count, Platelet aggregation test, PT, INR APTT, Mixing experiments in PT and APTT, Thrombin time.  Blood Components Preparation (Packed Cell, Plasma (FFP), LR-PCV, Granulocytes, Platelets)</p>	
5	<p><b>Blood Transfusion</b>  Principal &amp; Practice of blood Transfusion-Blood, Guide lines for the use of Blood, Appropriate use of Blood, Quality Assurance-Antilogous Blood Transfusion practices, Standard operating procedures for usage, donation &amp; storage of blood, screening of donor, compatibility testing, safety, procurement of supplies.  <b>Blood donation record book</b>-Recording results- Blood donor card-Documentation in blood bank</p>	12%
6	<p><b>Antigen and antibody reactions:</b>  Precipitation, Agglutination, Complement Fixation Test , Neutralisation, Opsonisation  <b>Principle of serological techniques;</b> Various serological test - WIDAL, VDRL, CRP, RF, ASO, Weil- Felix, Pregnancy rapid card test.  <b>Antibody production techniques:</b> Polyclonal sera, monoclonal antibody production, purification, enzyme conjugation, labelling, and immobilization</p>	13%
7	<p><b>Basics of Stem cell biology:</b>  Introduction, Stem cell evolution, <b>Embryonic &amp; adult stem cells:</b>  Embryonic stem cells- Isolation, properties, pluripotency &amp; differentiation;  Embryonic carcinoma cells- Teratomas &amp; teratocarcinoma; Adult Stem cells- Based on source (cord blood, bone marrow, adipose, endometrium, etc.) &amp; Lineages (HSC, MSC, SC, Endothelial Progenitor cells).</p>	12%
8	<p><b>Cell &amp; tissue banking:</b>  Definition &amp; cryopreservation, Scope and need cell &amp; tissue banking, Tissue processing, storage &amp; limitations; Cord blood banking: advantage &amp; disadvantages of cord blood banking, Regulation of cord blood banks, Donor recruitment, Cord blood collection, processing &amp; testing, Registration of cord blood units, search, issue and release for transplantation.</p>	13%

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

**M.Sc. – MLT (Part-II)**

Course Code	<b>PME02MLT05</b>		
Title of Subject	Practical – I (Pathology) Practical – II (Biochemistry) Practical – III (Microbiology)	Total Hours/Week	16
<b>Practical – I (Pathology)</b>			
<b>Pathology</b>			
<ol style="list-style-type: none"> <li>1. Test for Urine Exam</li> <li>2. Test for Stool examination</li> <li>3. Test for Semen examination</li> </ol>			
<b>Hematology and Blood Banking</b>			
<ol style="list-style-type: none"> <li>4. Collection of blood by various types of vacutainer</li> <li>5. Hb estimation</li> <li>6. Determination of Blood Groups (ABO and RH system)</li> <li>7. CM Tests</li> <li>8. Du Tests</li> <li>9. Comb's Tests,</li> <li>10. Determination of total leucocyte count and Differential leucocytes count (DLC).</li> <li>11. Sickling test.</li> <li>12. Determination of ESR by wintrobes &amp; Westergeren's method.</li> <li>13. Determination of PCV by Wintrobes</li> <li>14. Erythrocyte Indices- MCV, MCH, MCHC.</li> <li>15. Platelet count</li> <li>16. Reticulocyte count</li> <li>17. Bleeding time &amp; Clotting time</li> <li>18. Determination of prothrombin time (PT) &amp; APTT</li> <li>19. Automated Haematology Cell Counters (<b>Demonstration</b>)</li> </ol>			
<b>Histopathology</b>			
<ol style="list-style-type: none"> <li>20. To perform tissue processing by manual method.</li> <li>21. To perform section cutting by microtone of paraffin embedded tissue.</li> <li>22. To fix the smear on glass slide.</li> <li>23. To perform hematoxylin and eosinstaining.</li> <li>24. To perform PAS staining.</li> <li>25. To perform AFB staining (TB and leprosy)</li> </ol>			
<b>Practical – II (Biochemistry)</b>			
<ol style="list-style-type: none"> <li>1. Verification of Beer- Lambert Law by Spectrophotometry</li> <li>2. Qualitative identification of tests of sugars</li> <li>3. Determination of Blood Glucose and GTT (Glucose tolerance test)</li> <li>4. Determination of glycated hemoglobin (HbA1c)</li> <li>5. Estimation of Total serum protein by Folin Lowry method and albumin by BCG method</li> <li>6. Urine analysis – normal &amp; abnormal constituents of urine</li> <li>7. Estimation of Iron from serum</li> <li>8. Kidney Profile : Estimation of Urea &amp; Creatinine</li> <li>9. Estimation of Uric Acid</li> <li>10. To study the Lipid Profile-Cholesterol, Triglycerides, HDL Cholesterol, Free Fatty acid</li> <li>11. Determination of bilirubin</li> <li>12. Estimation of SGPT/ SGOT</li> <li>13. Estimation of Alkaline Phosphate/CPK/ LDH Enzyme</li> </ol>			

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

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14. Separation of DNA by Agarose Gel electrophoresis
15. Estimation of antioxidant (GSH)
16. Chromatography: TLC and Rf value
17. Estimation of Serum Amylase activity
18. Estimation of hCG using ELISA
19. Estimation of phenylalanine for Phenyl ketonuria
20. PCR (Demonstration)
21. Protein Blot (Western blot Demonstration)
22. Separation of serum protein by SDS-PAGE

**Practical – III (Microbiology)**

1. Demonstration and sterilization of equipment – Hot Air oven, Autoclave, Bacterial filters.
2. To study the preparation of commonly used culture media, culture methods Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, Mac conkey medium
3. Isolation of bacteria in pure culture
4. Preparation of broth and slant.
5. Methods of maintaining stock cultures.
6. Care and operation of Microscopes viz. Light and Fluorescence
7. Bacterial staining : Gram's stain, Spore stain, Leishman stain, Geimsa stain, Acid Fast staining
8. Sputum smear preparation and staining by Ziehl Nelsen (AFB).
9. Direct Examination of specimens (Mycology) by KOH, Gram, Kinyoun's, Giemsa, Lactophenol Cotton
10. Biochemical Reactions for identification of bacteria (Coagulase test, Catalase test, IMViC, Urease, Oxidase)
11. Tests for motility: hanging drop preparation
12. Antibiotic susceptibility test and MIC determination
13. Examination of blood for protozoa and helminths by wet mount, thin and thick stained smears.
14. Examination of faeces for parasitic ova and cysts etc. by direct and concentration methods (Salt flotation and Formol-Ether methods).
15. Leishman staining for malarial parasites
16. Antibiotic susceptibility test
17. Identification of fungal cultures Colony characteristics and Microscopic examination of Candida, Cryptococcus, Trichophyton,
18. To perform ASO test
19. Identification of Bacterial species using 16s RNA analysis.

**Immunology and Serology**

20. To perform radial immune-diffusion test
21. To perform TORCH profile
22. Performance of serological tests viz. Widal, VDRL/RPR
23. Latex agglutination tests: RA, CRP
24. Rapid tests (Immunochromatography or Flow through type) HIV
25. ELISA- Dot ELISA kit method
26. Radial immunodiffusion techniques (RID)

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar, Gujarat**  
**(Reaccredited with 'A' Grade by NAAC (CGPA 3.11))**  
**Syllabus with effect from the Academic Year 2024-2025**

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**Suggested Reference Book**

- Textbook of Medical laboratory technology by Praful B Godkar, Publisher Bhalan
- Textbook of Clinical laboratory methods and diagnosis by Gradwohls, Publisher Mosby
- Text book of Medical Laboratory Technology (6th edition) by Ramnik Sood, Jaypee Publication
- Mohan H. (2005). Textbook of Pathology, 5th ed., Jaypee Brothers Medical publishers
- Dacie, Practical Haematology
- Dr. Mukherjee, Medical Laboratory Technology, Volume I , II & II
- Wintrobe's Clinical Haematology, 14th edition, Lippincott Williams & Wilkins
- Text book of Medical Biochemistry by Chaterjee & Shinde, PublisherJPB
- Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company
- Textbook of Biochemistry for Medical Students (6th edition) DM Vasudevan, S Sreekumari and K Vaidyanathan 2011, Jaypee Medical Publishers, New Delhi.
- Biochemistry "Lippincott's Illustrated Reviews" (5th edition) RA Harvey (series editor), 2011, Lippincott Williams & Wilkins, Wolters Kluwer.
- A Text Book Medical Biochemistry: Chatterjee & Shinde
- Harper's Review of Biochemistry (29th edition) RK Murray, DA Bender, PJ Kennelly, VW Rodwell, and PA Weil. 2012, McGraw Hill Co.
- Satyanarayan, U. Chakrapani, Biochemistry, 3rd edition, Books & Allied Pvt Ltd Kolkatta
- Text book of Microbiology (7th Edition)- by Ananthanereyan & Paniker, Publisher Universities press.
- Anathanarayana & Panikar – A Text Book of Medical Microbiology
- Paniker's Text book of Parasitology (8th Edition)- C. K. Jayaram Paniker. The Health Sciences Publisher
- Prescott M, Harley John P., Microbiology, 8th edition, Lansing, Donald A. Klein, McGraw Hill.
- Essentials of Medical Microbiology by Apurba Sastry
- Textbook of Medical Mycology by Jagdish Chander
- Kuby's Immunology (7th Ed) - by J. Owen, J. Punt, S. Strandford. Macmillan Higher Education, England.
- Mackie and McCartney Medical Microbiology. A Guide to Laboratory Diagnosis and control of Infection.13th ed.,
- Molecular biology of cell- 5th Ed.- Bruce Alberts. (2008)
- Textbook of Medical Parasitology by P. Chakraborty
- Scott and Bailey's Diagnostic Microbiology.

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