

M. Sc. MEDICAL LABORATORY TECHNOLOGY

FIRST SEMESTER (COURSE STRUCTURE)

S. NO	PAPER CODE	THEORY PAPER	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
1.	MMLT-101	Clinical Biochemistry	40	60	100
2.	MMLT-102	General Microbiology	40	60	100
3.	MMLT-103	Clinical Hematology & Blood Banking	40	60	100
4.	MMLT-104	General Pathology	40	60	100
5.	MMLT-101 P	Lab Course -1 (Based on Paper 1 & 2)	40	60	100
6.	MMLT-102 P	Lab Course -2 (Based on Paper 3 & 4)	40	60	100
7.	MMLT-103 P	Clinical Training	40	60	100
		TOTAL	280	420	700

On the clinical training: 15 days is compulsory in each paper

SECOND SEMESTER (COURSE STRUCTURE)

S. NO	PAPER CODE	THEORY PAPER	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
1.	MMLT-201	Immunology	40	60	100
2.	MMLT-202	Techniques in Histopathology & Cytology	40	60	100
3.	MMLT-203	Human Physiology & Human Genetics	40	60	100
4.	MMLT-204	Endocrinology & Diagnostic Biochemistry	40	60	100
5.	MMLT-201 P	Lab Course -1 (Based on Paper 1 & 2)	40	60	100
6.	MMLT-202 P	Lab Course -2 (Based on Paper 3 & 4)	40	60	100
7.	MMLT-203 P	Clinical Training	40	60	100
		TOTAL	280	420	700

On the clinical training: 15 days is compulsory in each paper

**THIRD SEMESTER (COURSE STRUCTURE)
PATHOLOGY WITH HEMATOLOGY**

S. NO	PAPER CODE	THEORY PAPER	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
1.	MMLT-301(PH)	Advanced Hematology	40	60	100
2.	MMLT-302(PH)	Clinical Hematology (Non-neoplastic/Neoplastic)	40	60	100
3.	MMLT-303(PH)	Epidemiology & Biostatistics	40	60	100
4.	MMLT-304 (PH)	Advanced Instrumentation Techniques	40	60	100
5.	MMLT-301(PH) P	Lab Course -1 (Based on Paper 1 & 2)	40	60	100
6.	MMLT-302 (PH)P	Lab Course -2 (Based on Paper 3 & 4)	40	60	100
7.	MMLT-303(PH) P	Journal Club & Journal Reviews	40	60	100
		TOTAL	280	420	700

**THIRD SEMESTER (COURSE STRUCTURE)
PATHOLOGY WITH CLINICAL BIOCHEMISTRY**

S. NO	PAPER CODE	THEORY PAPER	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
1.	MMLT-301(CB)	Metabolic Biochemistry and related disorders	40	60	100
2.	MMLT-302(CB)	Diagnostic Enzymology	40	60	100
3.	MMLT-303(CB)	Epidemiology & Biostatistics	40	60	100
4.	MMLT-304 (CB)	Advanced Instrumentation Techniques	40	60	100
5.	MMLT-301(CB) P	Lab Course -1 (Based on Paper 1 & 2)	40	60	100
6.	MMLT-302(CB) P	Lab Course -2 (Based on Paper 3 & 4)	40	60	100
7.	MMLT-303 (CB) P	Journal Club & Journal Reviews	40	60	100
		TOTAL	280	420	700

**THIRD SEMESTER (COURSE STRUCTURE)
PATHOLOGY WITH MICROBIOLOGY**

S. NO	PAPER CODE	THEORY PAPER	INTERNAL MARKS	EXTERNAL MARKS	TOTAL
1.	MMLT-301(M)	Diagnostic Microbiology	40	60	100
2.	MMLT-302(M)	Clinical Virology and Mycology	40	60	100
3.	MMLT-303(M)	Epidemiology & Biostatistics	40	60	100
4.	MMLT-304 (M)	Advanced Instrumentation Techniques	40	60	100
5.	MMLT-301(M) P	Lab Course -1 (Based on Paper 1 & 2)	40	60	100
6.	MMLT-302(M) P	Lab Course -2 (Based on Paper 3 & 4)	40	60	100
7.	MMLT-303(M) P	Journal Club & Journal Reviews	40	60	100
		TOTAL	280	420	700

FOURTH SEMESTER (COURSE STRUCTURE)

Dissertation, which will carry 400 marks

The dissertation will be based upon the research and actual laboratory work. It will begin from 3rd Semester and will continue through the fourth one. The project report will be presented at the end of the fourth semester and evaluated (50% evaluation by the internal examiner and 50% evaluation by the external examiner).

Grand total = 700+700+700+400=2500 marks

I SEMESTER

Course Code: MMLT 101	MMLT-Semester-I Clinical Biochemistry	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To define concepts and principles of biochemistry, correlations of biomolecules	
CO2	To estimate fundamental aspects of enzymology and clinical application	
CO3	To integrate biochemical pathways of the intermediary metabolism along with their individual and integrated regulation	
CO4	To apply biochemical pathway and their integration in understanding the functioning of body with respect to energy liberating process.	
CO5	To understand molecular biology aspects	
CO6	To understand molecular biology techniques	
Course Content:		
Unit-1	Carbohydrates, Lipids, Proteins and nucleic acids- structure, Classification, Membrane structure, glycoproteins	8 Hours
Unit-2	Enzymes: Classification, factors that alter enzymes catalyzed reaction, Michaelis-Menton. Equation, Competitive and non-competitive inhibition of enzyme reactions, regulations enzyme activity, Coenzymes.	7 Hours
Unit-3	Carbohydrate Metabolism; glycolysis, TCA cycle, glycogen, gluconeogenesis, blood glucose regulation. Lipid Metabolism: Synthesis and breakdown of fatty acids, Ketone bodies DKA, Cholesterol, bile acids. Protein Metabolism: Synthesis and breakdown of amino acids, urea cycle, specialized products from amino acids.	6 Hours
Unit-4	Bioenergetics and oxidative phosphorylation; free energy-exergonic and endergonic reaction, high energy phosphates, components of electron transport chain-mechanism of ATP production, chemiosmotic theory, inhibitor of respiratory chain.	8 Hours
Unit-5	Molecular Biology: Structure and function DNA, Organization and replication transcription, Protein synthesis. Recombinant DNA Technology, PCR, FISH	6 Hours
Text Books	1. Satyanarayan and Chakrapani, 2021. <i>Text Book Of Biochemistry</i> . 6 edition. Elsevier. 2. Vasudevan and Sree kumari, 1995. <i>Text Book of Biochemistry for</i>	

	<i>Medical Students</i> . Edition 1, Jaypee Brothers, New Delhi.	
Reference Books	<ol style="list-style-type: none">1. Styrer. <i>Biochemistry</i>. 9th edition. MacMillan2. Harper. <i>Illustrated Biochemistry</i>. 32nd Edition. McGraw Hill.	

Course Code: MMLT-102	MMLT-Semester-I General Microbiology	L-4 T-0 P-2 C-5
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the History of microbiology in detail and study the morphology and physiology of bacteria.	
CO2	To discuss the principles of Sterilization, Disinfection, Cultivation methods and Antibiotic Susceptibility testing.	
CO3	To Explain the concept of viruses and their classification.	
CO4	To understand the different viruses and associated diseases.	
CO5	To understand the classification of protozoan	
CO6	To analyze opportunistic infection	
Course Content:		
Unit-1	Brief history of microbiology with special reference to the contributions of Louis Pasteur, Robert Koch and others. Morphology and physiology of Bacteria Classification and growth requirement of Bacteria Principles and uses of different kinds of Microscopes.	8 Hours
Unit-2	Sterilization and disinfection procedures. Basic principles of Bacterial genetics. Cultivation methods. Antibiotic –antibiotic susceptibility testing.	7 Hours
Unit-3	Sources and modes of transmission of infection with prevention of hospital-acquired infection. Definition of Epidemic, Endemic, Pandemic and the sporadic outbreak of diseases Virulence factors of Bacteria.	6 Hours
Unit-4	Classification and general properties of viruses and Bacteria: – interferon, inclusion bodies Cultivation of viruses, clinical manifestations and laboratory diagnostic methods of viral diseases and bacterial diseases	8 Hours
Unit-5	General properties of fungi and Parasites: cultivation methods, laboratory methods of diagnosing fungal infection, classification.	7 Hours
Text Books:	<ol style="list-style-type: none"> 1. Sastry and Bhat, 2021.<i>Essentials of Medical Microbiology</i>. Third Edition. Jaypee publishers. 2. Baweja, 2018. <i>Textbook of Microbiology</i>. Sixth Edition. Arya Publications. 	
Reference Books	<ol style="list-style-type: none"> 1. Ananthanarayan and Paniker's. <i>Textbook of Microbiology</i>. Twelvth Edition. Orient Blackswan. 	

	2. Greenwood, <i>Medical Microbiology</i> . Eighteenth Edition. Churchill Livingstone Elsevier.	
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Course Code: MMLT-103	MMLT-Semester-I Clinical Hematology & Blood Banking	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To examine the role of laboratory techniques including sample collection and investigation procedures.	
CO2	To understand the role of different techniques in hematology.	
CO3	To analyze blood analyzer and allied techniques	
CO4	To understand the molecular biology techniques in hematology and instruments.	
CO5	To assess the blood transfusion studies and procedures conducted in Blood Bank	
CO6	To prepare the classification and diagnosis of Haemolytic and malignant disorders in detail.	
Course Content:		
Unit-1	Basic Principles of laboratory organization and safety. Sample Collection – principles of analytical, pre and post analytical errors Reception, labelling and recording of laboratory investigations Cleaning of glassware, pipettes, E.S.R tubes and counting chambers Preparation of capillary pipette, distilled water, reagents, buffers.	8 Hours
Unit-2	Basic techniques in Molecular Biology and cytogenetics. Equipment relevant to lab haematology and transfusion medicine including Microscope: Light, phase contrast, interference, fluorescence, polarization and electron microscopy (principle, parts and its application).	7 Hours
Unit-3	Blood analyzer: Principal, instrument and its application. Incubator, hot air oven and autoclave: Principal, instrument and its application	6 Hours
Unit-4	Automated coagulation analysers, platelet aggregometers and thromboelastogram Haemopoiesis. Red Blood Cells : Normal erythropoiesis, morphology Red cell disorders – inherited and acquired. Anemias – classification, pathophysiology and diagnosis Haemolytic disorders. Malignant disorders	8 Hours
Unit-5	White Cells – Normal myelopoiesis, White cell disorders - inherited and acquired Malignant disorders – classification, pathophysiology and diagnosis Platelet disorders – classification, diagnosis and pathophysiology.	7 Hours
Text Books:	1. Harshmohan. <i>Text book of Pathology</i> . 8 th Edition. Jaypee	

	<p>Publishers.</p> <p>2. Godkar. <i>Text Book of Medical Laboratory Technology</i>. Third Edition. Volume 2. Bhalani Publishers..</p>	
Reference Books	<p>1. Robbins. <i>Basic Pathology</i>. 10th Edition. Elsevier.</p>	

CourseCode: MMLT-104	MMLT-Semester-I General Pathology	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the basics of pathological processes including cell death and injury, inflammation and thrombosis.	
CO2	To understand the basics of inflammation and thrombosis.	
CO3	To discuss the genetics and associated disorders.	
CO4	To assess the lab diagnosis, etiology and pathogenesis of emerging diseases.	
CO5	To evaluate the concept of molecular genetics of human diseases, disorders and diagnosis	
CO6	To generalize the concept of cell cycle and allied processes	
Course Content:		
Unit-1	General introduction to pathology causes of cell injury, cell injury and necrosis Apoptosis and sub-cellular responses to cell injury Cellular responses to growth and differentiation, pathologic calcification.	8 Hours
Unit-2	Acute and chronic inflammation, morphologic patterns of acute and chronic inflammation, systemic effects of inflammation Complements and their functions Cytokines and their functions Intracellular accumulation, gangrene – pathology and classification, pathogenesis and classification of edema, reticulocyte structure. Pathogenesis of thrombosis, embolism, infarction and shock.	7 Hours
Unit-3	Genetics (molecular basis of human diseases, production of human biologically active agents, gene therapy, disease diagnosis, mutations, Mendelian disorders, autosomal dominant disorders, autosomal recessive disorders and X linked disorders Biochemical and molecular basis of single gene disorders. Disorders with multifactorial inheritance, normal karyotype, fluorescence in situ hybridization, cytogenetic disorders involving sex chromosomes. Diagnosis of genetic diseases. Direct gene diagnosis, indirect gene diagnosis, linkage analysis.	6 Hours
Unit-4	Infectious diseases, new and emerging infectious diseases, categories of infectious diseases in brief, special techniques for diagnosing infections	8 Hours

	Tuberculosis-etiology, pathogenesis and lab diagnosis Leprosy – etiology, pathogenesis and lab diagnosis HIV- epidemiology, pathogenesis and lab diagnosis	
Unit-5	Control of normal growth, cell cycle illustration and the regulation of cell division, labile cells, stable cells, permanent cells, molecular events in cell growth (autocrine signalling, paracrine signaling, endocrine signaling), cell surface receptors, signal transduction systems and transcription factors.	7 Hours
Text Books:	<ol style="list-style-type: none"> 1. Harshmohan. <i>Text book of Pathology</i>. 8th Edition. Jaypee Publishers. 2. Godkar. <i>Text Book of Medical Laboratory Technology</i>. Third Edition. Volume 1&2. Bhalani Publishers. 3. Ramnik Sood. <i>Text Book of Medical Laboratory Technology</i>. Second Edition. Jaypee Publishers.. 	
Reference Books	1. Robbins. <i>Basic Pathology</i> . 10 th Edition. Elsevier	

Note: Course Out comes of following practical is covered in their respective theory course

Course Code: MMLT-101P	MMLT- Semester-I Practical: Lab Course -1 (Based on Paper 1 & 2)	P-2 C-1
Course Content:		
1	Preparation of buffers	
2.	Determination of pH	
3.	Colour reactions of Aminoacids	
4.	Identification of Normal constituents of Urine	
5.	Identification of Abnormal constituents of Urine	
6.	Body fluid examination	
7.	Carbohydrate identification	
8.	Preparation of molar solution	
9.	Handling of microscope, staining methods	
10.	Preparation of media, inoculation methods.	
11.	Preservation of cultures, anaerobic cultivation methods	
12.	Techniques of filtration, maintenance of quality control antibiotic susceptibility testing Molecular techniques	
13.	Demonstration of agglutination precipitation.	
14.	Demonstration of neutralization.	
15.	Demonstration fluorescent Antibody technique.	
16.	Demonstration of immune blot technique.	
17.	Stool examination for ova and cysts.	

Note: Experiments are subject to availability of chemicals/instruments.

Course Code: MMLT-102P	MMLT- Semester-I Practical: Lab Course -2 (Based on Paper 3 & 4)	P-2 C-1
Course Content:		
1	Blood grouping-ABO grouping, forward grouping (slide and tube method)	
2.	Rh grouping and Rh typing	
3.	Compatibility testing: Cross matching techniques	
4.	Investigation of blood transfusion reactions	
5.	Demonstration of Western blot	
6.	Demonstration of Northern blot	

7.	Demonstration of Southern blot	
8.	Demonstration of CD4 CD8 counts	
9.	Demonstration of RT-PCR	
10.	Demonstration of neoplasia.	
11.	Demonstration of benign epithelial tumors	
12.	Demonstration of malignant epithelial tumors	
13.	To perform hematoxylin stain	
14.	To perform Stains for neutral lipids	

Note: Experiments are subject to availability of chemicals/instruments.

<u>Course Code:</u> MMLT-103P	MMLT-Semester-I Clinical Training	
	Students will be assigned to several pathology labs where they will receive hands-on instruction in patient care, sample collection and processing, and handling of bodily fluids. Patient information is identified using the CR number, the lab number, and the transfer of samples from collecting centres to various labs, process of carrying out different tests at multiple labs. Each student is obliged to keep a record of all of their postings. The faculty will continuously assess student performance, and results will be displayed in various parts.	

II SEMESTER

Course Code: MMLT 201	MMLT-Semester-II Immunology	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To define concepts of immunity, immune system and its types	
CO2	To understand the concept of immunity and its types	
CO3	To evaluate the importance of immunity and Hypersensitivity with their types.	
CO4	To apply concept of antigen antibody reaction in different immunochemical techniques..	
CO5	To define the vaccine and its implementation program	
CO6	To understand molecular biology techniques	
Course Content:		
Unit-1	Immune system and its history, types of immunity- innate and adaptive immunity; active and passive immunity. Primary and secondary immune response Antigen, antibody definition, examples. Antigen-antibody reaction – principles and their application in the diagnosis of infectious diseases.	8 Hours
Unit-2	Immunity- classification, active immunity, passive immunity, innate immunity, humoral and cell-mediated immunity, immunization schedule	7 Hours
Unit-3	Hypersensitivity classification, mechanism and example autoimmunity – mechanism and example tumour and transplantation immunology.	6 Hours
Unit-4	Demonstration of antigen–antibody reaction, concept of affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immune electrophoresis and ELISA (indirect, competitive, sandwich) chemiluminescence, and ELISPOT assay, Western blotting, immunofluorescence, and flow cytometry.	8 Hours
Unit-5	Vaccine and its type, general idea of National Immunization Course Rheumatological diseases, etiology and pathogenesis and laboratory investigations	6 Hours
Text Books	<ol style="list-style-type: none"> 1. Peak man M, and Vergani D. (2009). <i>Basic and Clinical Immunology</i>. 2nd edition 2. Churchill Livingstone Publishers, Edinberg. Richard C and Geoffrey S. (2009). <i>Immunology</i>. 6th edition. Wiley Blackwell Publication. 3. Baweja, 2018. <i>Textbook of Microbiology</i>. Sixth Edition. Arya 	

	Publications.	
Reference Books	<ol style="list-style-type: none">1. Park & Park, Preventive & Social Medicine2. Ananthanarayan and Paniker's. <i>Textbook of Microbiology</i>. 12th Edition. Orient Blackswan.	

Course Code: MMLT 202	MMLT-Semester-II Techniques in Histopathology & Cytology	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To memorize the basic histopathological staining techniques.	
CO2	To extend the knowledge on enzyme histochemistry and immunoenzyme techniques.	
CO3	To apply the concept of immunohistochemistry in the diagnosis of various disorders.	
CO4	To explain the Cytology techniques, quantitative methods and micro incineration.	
CO5	To evaluate the applications of autoradiography techniques for disease diagnosis.	
CO6	To develop an understanding of Microscopy, its types and immunofluorescence.	
Course Content:		
Unit-1	PAS (Period acid – Schiff) Stain Stain for micro-organisms Argentaffin and argyrophil stains Amyloid stains. Reticulin Stains Trichrome stains. Phosphotungstic acid hematoxylin stain (PTAH) Stains for hemosiderin, Melanin and CA Stains for neural lipids. Mucin stains Giemsa Stain Elastic stain Myelin stain Romanowsky stain	8 Hours
Unit-2	Enzyme histochemistry and immunoenzyme techniques. Immunohistochemistry and the various immunohistochemical stains in the diagnosis of various –disorders. Tissues of special interest – nervous system Hard tissue. Miscellaneous cells Endocrine cells	7 Hours
Unit-3	Cytology techniques Quantitative methods Micro incineration. Flow cytometry- Other methods for analysis of cell proliferation and Nucleolar Organiser region evaluation polymerase chain reaction and application of PCR technology in Pathology cytogenetics interphase cytogenetics	6 Hours
Unit-4	Autoradiography Museum tech. Specimen photography and microphotography.	8 Hours
Unit-5	Microscopy General Microscopy. Dark ground microscopy Immunofluorescence and fibers and formaldehyde induced fluorescence Fluorescence microscopy	6 Hours

	Polarizing microscopy Phase contrast microscopy Electron microscopy	
Text Books	<ol style="list-style-type: none"> 1. Harshmohan. <i>Text book of Pathology</i>. 8th Edition. Jaypee Publishers. 2. Godkar. <i>Text Book of Medical Laboratory Technology</i>. Third Edition. Volume 1&2. Bhalani Publishers. 3. Ramnik Sood. <i>Text Book of Medical Laboratory Technology</i>. Second Edition. Jaypee Publishers 	
Reference Books	<ol style="list-style-type: none"> 1. Robbins. <i>Basic Pathology</i>. 10th Edition. Elsevier 	

Course Code: MMLT 203	MMLT-Semester-II Human Physiology & Human Genetics	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To explain the functions of cardiovascular system and its physiology.	
CO2	To extend the knowledge Musculo-skeletal system and muscle contraction physiology.	
CO3	To understand physiology of different body fluids.	
CO4	To understand the concepts of genetic disorders	
CO5	To analyze biochemical and molecular basis of single gene disorders	
CO6	To discuss about the techniques related to genetics	
Course Content:		
Unit-1	Organs of cardiovascular system, organs of the system, mechanism and physiology of blood flow through the cardiovascular system	8 Hours
Unit-2	Musculo-skeletal system, classification & functions of bones and muscles. Physiology of muscular contraction and factor controlling them various types of joints and their physiology	7 Hours
Unit-3	Physiology of various body fluids: CSF, Peritoneal, Pericardial, Pleural and synovial fluids.	6 Hours
Unit-4	Genetics (molecular basis of human diseases, production of human biologically active agents, gene therapy, disease diagnosis, mutations, Mendelian disorders, autosomal dominant disorders, autosomal recessive disorders and X linked disorders	8 Hours
Unit-5	Biochemical and molecular basis of single gene disorders. Disorders with multifactorial inheritance, normal karyotype, fluorescence in situ hybridization, cyto genetic disorders involving sex chromosomes. Diagnosis of genetic diseases. Direct gene diagnosis, indirect gene diagnosis, linkage analysis	6 Hours
Text Books	1. Text Book of Human Anatomy B D Chourasia's V Edition. 2. Harshmohan. <i>Text book of Pathology</i> . 8 th Edition. Jaypee Publishers.	
Reference Books	1. Atlas Of Human Anatomy by Frank H. Netter VII Edition	

Course Code: MMLT 204	MMLT-Semester-II Endocrinology & Diagnostic Biochemistry	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To memorize the basic concepts of endocrinology.	
CO2	To extend the knowledge on Hypothalamus and pituitary organs and their assessment.	
CO3	To apply the concept of Thyroid anatomy and the diagnosis of various disorders.	
CO4	To explain the concept of Adrenal gland and its assessment.	
CO5	To evaluate the Gastrointestinal and pancreatic hormones and their role in disease diagnosis.	
CO6	To develop an understanding hormone and its action.	
Course Content:		
Unit-1	General concepts of endocrinology- the endocrine system, hormones-chemical nature, classification, hormonal action- receptors, hormone receptor interaction, regulation of gene expression by hormones, second messengers (camp, GMP, Ca ⁺⁺) protein kinase cascade. Concepts of hormones assay	8 Hours
Unit-2	Hypothalamus and pituitary- anatomy, chemistry, functions, regulation, diseases related to the hormones of these glands. Assessment of anterior and posterior pituitary	7 Hours
Unit-3	Thyroid anatomy, chemistry, synthesis, functions, regulation, thyroid function test in various abnormal conditions, parathyroid- anatomy, chemistry, synthesis, functions, regulations, diseases of parathyroid glands. Hormones involved in calcium and phosphate metabolism. Diseases related to its metabolism calcium chemistry and functions	6 Hours
Unit-4	Adrenal cortex and medulla- anatomy, chemistry, synthesis, metabolic effects, pathophysiology of the adrenal cortex. Assessment of adrenal functions, Gonadal hormones- anatomy, chemistry, functions, regulations and diseases related to these glands. Endocrinology of male and female infertility, pregnancy and lactation	8 Hours
Unit-5	Gastrointestinal and pancreatic hormones- chemistry, synthesis, metabolic effects, regulation, diseases related to the hormones of these glands. Detection of anomalies	6 Hours
Text Books	1. Satyanarayan and Chakrapani, 2021. <i>Text Book Of Biochemistry</i> .	

	<p>6 edition. Elsevier.</p> <p>2. Vasudevan and Sree kumari, 1995. <i>Text Book of Biochemistry for Medical Students</i>. Edition 1, Jaypee Brothers, New Delhi.</p> <p>3. Chatterjee and Rana Shinde. <i>Text Book of Medical biochemistry</i> . Jaypee Publishers.</p>	
Reference Books	<p>1. Styrer. <i>Biochemistry</i>. 9th edition. MacMillan</p> <p>2. Harper. <i>Illustrated Biochemistry</i>. 32nd Edition. McGraw Hill.</p>	

Note: Course Out comes of following practical is covered in their respective theory course

Course Code: MMLT-201P	MMLT- Semester-II Practical: Lab Course -1 (Based on Paper 1 & 2)	P-2 C-1
Course Content:		
1	Demonstration of agglutination precipitation.	
2.	Demonstration of neutralization.	
3.	Demonstration fluorescent Antibody technique.	
4.	Demonstration of immune blot technique.	
5.	Demonstration of CMI Test to demonstrate hypersensitivity.	
6.	Demonstration of ELISA	
7.	To perform Romanowsky stain	
8.	To perform hematoxylin stain (PTAH).	
9.	To perform PAS (Periodic Acid-Schiff) stain	
10.	To perform Stains for hemodierin (Perls)	
11.	To perform Elastic fibers Myelin stains	
12.	To perform Stains for neutral lipids	

Note: Experiments are subject to availability of chemicals/instruments.

Course Code: MMLT-202P	MMLT- Semester-II Practical: Lab Course -2 (Based on Paper 3 & 4)	P-2 C-1
Course Content:		
1	Study of Microscope	
2.	Study of cell structure	
3.	Study of mitosis and meiosis cell division	
4.	Demonstration of karyotyping	
5.	Demonstration of Separation of Nucleic acid	
6.	Demonstration of FISH	
7.	Estimation of calcium, Phosphorous, Magnesium, Iron	
8.	Estimation of Electrolytes	
9.	Quantitative analysis of Urine-Protein, Uric acid, Creatinine, Calcium chloride	
10.	Analysis of CSF	
11.	Hormones: Thyroid profile- FT2, FT4, TSH	
12.	Fertility profile – LH, FSH, prolactin, estradiol, testosterone	

13.	Estimation of cortisol, insulin	
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Note: Experiments are subject to availability of chemicals/instruments.

<u>Course Code:</u> MMLT-203P	MMLT-Semester-II Clinical Training	
	Students will be assigned to several pathology labs where they will receive hands-on instruction in patient care, sample collection and processing, and handling of bodily fluids. Patient information is identified using the CR number, the lab number, and the transfer of samples from collecting centres to various labs. process of carrying out different tests at multiple labs. Each student is obliged to keep a record of all of their postings. The faculty will continuously assess student performance, and results will be displayed in various parts.	

III SEMESTER

PATHOLOGY WITH HEMATOLOGY

CourseCode: MMLT-301(PH)	MMLT-Semester-III Advanced Hematology	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the basics of blood disorders and analysis using analytical techniques.	
CO2	To discuss the analysis and interpretation of urine and stool.	
CO3	To illustrate the immunohematology techniques for studying the Blood group system.	
CO4	To explain the Blood group compatibility and its clinical significance.	
CO5	To evaluate quality control of blood bank system.	
CO6	To develop an understanding of transfusion reactions and HDN disease.	
Course Content:		
Unit-1	Coagulation disorders and basics of their work up Thrombotic disorders and basics of testing Automated cell counters and coagulation analysers – principles Manual Haemoglobin and Counts.	8 Hours
Unit-2	Peripheral smear –Preparation and Interpretation Manual tests of coagulation, factor assays. Urine and stool – analysis, micro and interpretation.	7 Hours
Unit-3	Immunohaematology: Basic Genetics and immunology ABO and Rh blood group systems. Other major blood group systems – clinical significance of Compatibility testing, Antibody screening and identification, clinical significance of Choice of reagents and QA of the same Donor Screening and bleeding.	6 Hours
Unit-4	Blood bags, Anticoagulant and preservative solutions Blood Components – preparation, Quality control Apheresis.	8 Hours
Unit-5	Infectious disease screening. Transfusion reactions, Haemolytic Disease of the Newborn Some basics of appropriate use of blood. Choice of blood in specific clinical scenarios – HDN, Multiply transfused etc Basics of HLA typing and anti-HLA antibody detection.	7 Hours

Text Books:	<ol style="list-style-type: none">1. Tejinder Singh. <i>Text Book of haematology</i>. Arya Publications.2. Rakesh Joshi. <i>Text Book of Clinical pathology, Haematology and Blood Banking</i>.	
Reference Books	<ol style="list-style-type: none">1. Robbins. <i>Basic Pathology</i>. 10th Edition. Elsevier	

CourseCode: MMLT-302(PH)	MMLT-Semester-III Clinical Hematology (Non-neoplastic/Neoplastic)	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe growth inhibition and cell-cell adhesions.	
CO2	To discuss the angiogenesis and its regulation.	
CO3	To illustrate molecular mechanisms of neoplasia and cancer.	
CO4	To explain the role of tumor suppressor genes.	
CO5	To evaluate apoptosis and its mechanism.	
CO6	To develop an understanding of DNA repair.	
Course Content:		
Unit-1	Growth inhibition, growth factors, extra cellular matrix and cell matrix interactions, collagen, elastin, fibrillin and elastic fibres, adhesive glycoproteins and integrins, matricellular proteins, proteoglycans and hyaluronidase.	8 Hours
Unit-2	Repair by connective tissue-angiogenesis, growth factors and receptors for angiogenesis, extra cellular matrix proteins as regulators of angiogenesis. Fibrosis, tissue modeling, wound healing, healing by first and second intention. Haemo dynamic disorders – hemostasis and thrombosis.	7 Hours
Unit-3	Neoplasia, Nomenclature, characteristics of benign and malignant neoplasms.Molecular basis of cancer, oncogenes and cancer, protein products of oncogenes./Activation of oncogenes, point mutations, chromosomal rearrangements, gene amplification, cancer	6 Hours
Unit-4	Suppressor genes, protein products of tumor suppressor genes. Molecules that regulate nuclear transcription and cell cycle, Rb gene, P53 gene, BRCA-1 and BRCA-2 gene, molecules that regulate signal transduction, cell surface receptors, other tumor suppressor genes.	8 Hours
Unit-5	Genes that regulate apoptosis and DNA repair, Telomeres and cancer, molecular growth, Kinetics of tumor cell growth, tumor, tumor angiogenesis. Lab diagnosis of cancer.	7 Hours
Text Books:	1. Harshmohan. <i>Text book of Pathology</i> . 8 th Edition. Jaypee Publishers.	

	<ol style="list-style-type: none">2. Godkar. <i>Text Book of Medical Laboratory Technology</i>. Third Edition. Volume 1&2. Bhalani Publishers.3. Ramnik Sood. <i>Text Book of Medical Laboratory Technology</i>. Second Edition. Jaypee Publishers.	
Reference Books	<ol style="list-style-type: none">1. Robbins. <i>Basic Pathology</i>. 10th Edition. Elsevier	

Course Code: MMLT-303(PH)	MMLT-Semester-III Epidemiology & Biostatistics	L-3 T-0 P-0 C-3
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the epidemiology of the disease, its transmission and control.	
CO2	To discuss the importance of prevention and control of communicable and non-communicable diseases and interpretation of the epidemiological data.	
CO3	To present the published research including the need of screening tests, its accuracy and types of study design.	
CO4	To analyse the data using various statistical sampling methods.	
CO5	To evaluate the data using statistical interference methods	
CO6	To prepare a result out of the data using Anova.	
Course Content:		
Unit-1	Epidemiology - definition, concept and role in health and disease. Definition of the terms used in describing disease transmission and control. Modes of transmission and natural history of a disease Measures for prevention and control of communicable and non-communicable disease. Principal sources of epidemiological data	8 Hours
Unit-2	Definition, calculation and interpretation of the measures of frequency of diseases and mortality. Need and uses of screening tests. Accuracy and clinical value of diagnostic and screening tests (sensitivity, specificity, & predictive values). Causal Association & Various types of epidemiological study designs Critical evaluation of published research	7 Hours
Unit-3	Frequency distribution: diagrams, characteristics of a frequency distribution Basic distribution statistics: measures of central tendencies. Measures of variation/dispersions Confidence intervals. Measures of accuracy and precision Statistical sampling methods. Basic for statistical inference Sampling distribution Statistical inference. Statistical inference.	6 Hours
Unit-4	Type I and Type II errors. Parametric comparison of populations. The null hypothesis and statistical significance Comparison of means test including paired test One way analysis of variance (ANOVA).	8 Hours

Unit-5	Non Parametric distribution statistics Sign test Mann-Whitney rank sum test X^2 (Chi Square) test. Linear regression and correlation Scatter diagram Correlation coefficient Regression coefficient Multiple regression. Sensitivity, specificity and predictive values Receiver – operating characteristics curve.	7 Hours
Text Books:	1. Gupta. <i>Research Methodology</i> . Second Edition. International Book House Ltd.	
Reference Books	1. Kothari. <i>Research Methodology</i> . Fourth Edition. New Age International Publishers.	

CourseCode: MMLT-304(PH)	MMLT-Semester-III Advanced Instrumentation Techniques	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To understand different types of staining procedures.	
CO2	To apply microscopy in the laboratory experiments.	
CO3	To illustrate analytical techniques and their application in hematology.	
CO4	To explain recombinant DNA technology and related techniques.	
CO5	To apply different centrifugation procedures in the laboratory experiments.	
CO6	To develop an understanding radioisotopes and their uses in biology.	
Course Content:		
Unit-1	Different types of stains and their procedures.	8 Hours
Unit-2	Microscopy-Light, phase contract, fluorescence electron microscopy Electron microscope, working principles, components and allied techniques for electron microscopy, ultra-microtomy	7 Hours
Unit-3	Dialysis, electrophoresis, immune electrophoresis, isoelectric focusing, isotachopheresis, capillary electrophoresis. Application of electrophoresis in biology. Coulter counter apheresis machines centrifugation	6 Hours
Unit-4	Recombinant DNA technology-PCR, western blotting, northern blotting and southern blotting.	8 Hours
Unit-5	Radioisotopes, nature of radioactivity, types of radioactivity, and radioactive decay. Units of radioactivity. Detection and measurement of radioactivity. Concept of proportional scintillation and gamma counters. Autoradiography. Uses of radio isotopes in biology.	7 Hours
Text Books:	1. <i>Text Book of Pathology</i> by Harsh Mohan VIII Edition 2. <i>Text Book of Pathology</i> by Dr. A K Mandal	

	<p>3. Godkar.B. Praful,(2016) <i>Textbook of Medical Lab Technology</i>, 3rd edition, Bhalani Publications</p> <p>4. P.K Bajpai. <i>Biological Instrumentation & Methodology</i> (2010) S. Chand Publishing.</p>	
Reference Books	<p>1. Clinical Pathology Haematology & Blood Banking IV Edition Nanda Maheshwari</p> <p>2. Exam Oriented Pathology by K Mukhopadhyay</p>	

Note: Course Out comes of following practical is covered in their respective theory course

<u>Course Code:</u> MMLT- 301(PH)P	MMLT- Semester-I Practical: Lab Course -1 (Based on Paper 1 & 2)	P-2 C-1
Course Content:		
1	Preparation of blood smears.	
2.	Staining of blood smears.	
3.	Demonstration of coagulation analyzer.	
4.	Rh grouping and Rh typing.	
5.	Compatibility testing: Cross matching techniques.	
6.	Demonstration of Polymerase chain reaction	
7.	Demonstration of In situ hybridization	
8.	Demonstration of DNA microarrays	

Note: Experiments are subject to availability of chemicals/instruments.

<u>Course Code:</u> MMLT- 302(PH)P	MMLT- Semester-I Practical: Lab Course -2 (Based on Paper 3 & 4)	P-2 C-1
Course Content:		
1	Demonstration of spectrophotometer.	
2.	Separation of amino acids by paper chromatography	
3.	Separation of proteins by PAGE	
4.	Separation of DNA by Agarose Gel Electrophoresis	
5.	Demonstration of atomic absorption spectroscopy	
6.	Demonstration of western blotting.	
7.	Demonstration of flow cytometer	

Note: Experiments are subject to availability of chemicals/instruments.

<u>Course Code:</u> MMLT- 303(PH)P	MMLT-Semester-III Journal Club & Journal Reviews	
	The student's capacity for thorough research, oral and written presentation, and the use of visual aids will be evaluated. Faculty members and peers present at the meeting make the evaluation.	

III SEMESTER
PATHOLOGY WITH CLINICAL BIOCHEMISTRY

CourseCode: MMLT-301(CB)	MMLT-Semester-III Metabolic Biochemistry and related disorders	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To interpret the metabolic disorders of carbohydrate metabolism.	
CO2	To discuss the metabolic disorders of lipid metabolism.	
CO3	To understand the metabolic disorders of protein metabolism.	
CO4	To explain the Blood group gas analysis and its clinical significance.	
CO5	To evaluate composition of CSF.	
CO6	To develop an understanding of AIDS.	
Course Content:		
Unit-1	Disorders of Carbohydrates metabolism: diabetes mellitus- diagnosis, gestation diabetes mellitus, role of laboratory in diagnosis and prognosis in diagnosis and prognosis, hypoglycemia. Determination of glucose in body fluids, ketone bodies, lactate and pyruvate.	8 Hours
Unit-2	Disorders of lipid Metabolism: Atherosclerosis and coronary artery disease. Disorders of lipoprotein metabolism, Measurement of lipids, lipoproteins and apolipoproteins. Sources of analytical and biological variations in measurements.	7 Hours
Unit-3	Disorders of Protein metabolism: plasma proteins, proteins in body fluids. Analysis of proteins in blood and other body fluids. Electrophoresis of plasma proteins. Amino acidurias- selected disorders of amino acid metabolism- phenylalanine, tyrosine, alkaptonuria, melanuria, cystinula, homocystinuria, cystinosis, organic acidurias.	6 Hours
Unit-4	Electrolytes and blood gas analysis- specimens for electrolyte determination- sodium, potassium, chloride, bicarbonate, determination of pCO ₂ , O ₂ and pH.	8 Hours
Unit-5	Composition of CSF, meningitis, encephalitis, AIDS- basic concepts, diagnosis.	7 Hours
Text Books:	1. Satyanarayan and Chakrapani, 2021. <i>Text Book Of Biochemistry</i> . 6 edition. Elsevier. 2. Vasudevan and Sree kumari, 1995. <i>Text Book of Biochemistry</i>	

	<p><i>for Medical Students</i>. Edition 1, Jaypee Brothers, New Delhi.</p> <p>3. Chatterjee and Rana Shinde. <i>Text Book of Medical biochemistry</i> . Jaypee Publishers.</p>	
Reference Books	<ol style="list-style-type: none"> 1. Styrer. <i>Biochemistry</i>. 9th edition. MacMillan 2. Harper. <i>Illustrated Biochemistry</i>. 32nd Edition. McGraw Hill. 	

CourseCode: MMLT-302(CB)	MMLT-Semester-III Diagnostic Enzymology	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To discuss clinical enzymology and its role in diseases.	
CO2	To discuss the enzymes involved in Liver Function Tests.	
CO3	To understand the role of enzymes in Renal Function Tests.	
CO4	To explain the clinical significance of different enzymes.	
CO5	To evaluate enzymes involved in gastric and pancreatic function tests.	
CO6	To develop an understanding of clinical enzymes and their levels in diseases.	
Course Content:		
Unit-1	Clinical Enzymology: Enzymes in plasma and their origin, general principles of the assay, the clinical significance of enzymes and isoenzymes, measurement of serum enzymes in diagnosis- cardiac and skeletal muscle enzymes, liver and biliary tract enzymes digestive, bone GI disorders..	8 Hours
Unit-2	Enzymes involved in Liver Function Test, Jaundice, hepatitis, cholestasis.	7 Hours
Unit-3	Enzymes involved in Renal function test, renal failure, uremia, nephritic syndrome, renal calculi, renal tubular acidosis, diabetes insipidus, dialysis.	6 Hours
Unit-4	Clinical importance of creatine kinase, transaminases, phosphatases, LDH, isocitrate dehydrogenase, glutamate dehydrogenase, choline esterase, glucose-6-phosphate dehydrogenase, chymotrypsin and ceruloplasmin.	8 Hours
Unit-5	Enzymes involved in Gastric and pancreatic function tests, pancreatitis, and malabsorption syndrome.	7 Hours
Text Books:	1. Satyanarayan and Chakrapani, 2021. <i>Text Book Of Biochemistry</i> . 6 edition. Elsevier. 2. Vasudevan and Sree kumari, 1995. <i>Text Book of Biochemistry for Medical Students</i> . Edition 1, Jaypee Brothers, New Delhi. 3. Chatterjee and Rana Shinde. <i>Text Book of Medical biochemistry</i> . Jaypee Publishers.	
Reference Books	1. Styrer. <i>Biochemistry</i> . 9 th edition. MacMillan 2. Harper. <i>Illustrated Biochemistry</i> . 32 nd Edition. McGraw Hill.	

Course Code: MMLT-303(CB)	MMLT-Semester-III Epidemiology & Biostatistics	L-3 T-0 P-0 C-3
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the epidemiology of the disease, its transmission and control.	
CO2	To discuss the importance of prevention and control of communicable and non-communicable diseases and interpretation of the epidemiological data.	
CO3	To present the published research including the need of screening tests, its accuracy and types of study design.	
CO4	To analyse the data using various statistical sampling methods.	
CO5	To evaluate the data using statistical interference methods	
CO6	To prepare a result out of the data using Anova.	
Course Content:		
Unit-1	Epidemiology - definition, concept and role in health and disease. Definition of the terms used in describing disease transmission and control. Modes of transmission and natural history of a disease Measures for prevention and control of communicable and non-communicable disease. Principal sources of epidemiological data	8 Hours
Unit-2	Definition, calculation and interpretation of the measures of frequency of diseases and mortality. Need and uses of screening tests. Accuracy and clinical value of diagnostic and screening tests (sensitivity, specificity, & predictive values). Causal Association & Various types of epidemiological study designs Critical evaluation of published research	7 Hours
Unit-3	Frequency distribution: diagrams, characteristics of a frequency distribution Basic distribution statistics: measures of central tendencies. Measures of variation/dispersions Confidence intervals. Measures of accuracy and precision Statistical sampling methods. Basic for statistical inference Sampling distribution Statistical inference. Statistical inference.	6 Hours
Unit-4	Type I and Type II errors. Parametric comparison of populations. The null	8 Hours

	hypothesis and statistical significance Comparison of means test including paired test One way analysis of variance (Anova).	
Unit-5	Non Parametric distribution statistics Sign test Mann-whitney rank sum test X^2 (Chi Square) test. Linear regression and correlation Scatter diagram Correlation coefficient Regression coefficient Multiple regression. Sensitivity, specificity and predictive values Receiver – operating characteristics curve.	7 Hours
Text Books:	1. Gupta. <i>Research Methodology</i> . Second Edition. International Book House Ltd.	
Reference Books	1. Kothari. <i>Research Methodology</i> . Fourth Edition. New Age International Publishers.	

CourseCode: MMLT-304(CB)	MMLT-Semester-III Advanced Instrumentation Techniques	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To understand different types of spectroscopy.	
CO2	To apply different chromatographical procedures in the laboratory.	
CO3	To illustrate electrophoresis.	
CO4	To explain recombinant DNA technology and related techniques.	
CO5	To apply different centrifugation and electrochemistry in the laboratory.	
CO6	To develop an understanding of automation.	
Course Content:		
Unit-1	Spectrophotometry, flame emission spectrophotometry, atomic absorption spectrophotometry, fluorimetry, nephelometry, turbidimetry, flow Cytometry.	8 Hours
Unit-2	Chromatography- Theory, description of techniques of various types of chromatography, paper chromatography, HPLC.	7 Hours
Unit-3	Electrophoresis- Theory, description of techniques of various types of electrophoresis, technical considerations	6 Hours
Unit-4	Recombinant DNA technology-PCR, western blotting, northern blotting and southern blotting.	8 Hours
Unit-5	Electrochemistry-potentiometry, biosensors. Centrifugation Concept of automation	7 Hours
Text Books:	1. Satyanarayan and Chakrapani, 2021. <i>Text Book Of Biochemistry</i> . 6 edition. Elsevier. 2. Vasudevan and Sree kumari, 1995. <i>Text Book of Biochemistry for Medical Students</i> . Edition 1, Jaypee Brothers, New Delhi 3. P.K Bajpai. <i>Biological Instrumentation & Methodology</i> (2010) S. Chand Publishing.	
Reference Books	1. Wilson and Walker's <i>Principles and Techniques of Biochemistry and Molecular Biology</i> 8th edition (2017)	

Note: Course Out comes of following practical is covered in their respective theory course

Course Code: MMLT-301(CB)P	MMLT- Semester-III Practical: Lab Course -1 (Based on Paper 1 & 2)	P-2 C-1
Course Content:		
1	Estimation of blood glucose.	
2.	Estimation glycated haemoglobin.	
3.	Estimation of blood urea.	
4.	Estimation of serum creatinine.	
5.	Estimation of uric acid	
6.	Estimation of total bilirubin	
7.	Estimation of total protein	
8.	Estimation of albumin	
9.	Estimation of SGOT	
10.	Estimation of SGPT	
11.	Estimation of ALP	
12.	Estimation of GGT	
13.	Estimation of total cholesterol	
14.	Estimation of triglycerides	
15.	Estimation of HDL, LDL	
16.	Estimation of amylase	
17.	Estimation of LDH	
18.	Estimation of CK	

Note: Experiments are subject to availability of chemicals/instruments

Course Code: MMLT-302(CB)P	MMLT- Semester-III Practical: Lab Course -2 (Based on Paper 3 & 4)	P-2 C-1
Course Content:		
1	Demonstration of spectrophotometer.	
2.	Separation of amino acids by paper chromatography	
3.	Separation of proteins by PAGE	
4.	Separation of DNA by Agarose Gel Electrophoresis	
5.	Demonstration of atomic absorption spectroscopy	
6.	Demonstration of western blotting.	
7.	Demonstration of flow cytometer	

Note: Experiments are subject to availability of chemicals/instruments

<u>Course Code:</u> MMLT-303(CB)P	MMLT-Semester-III Journal Club & Journal Reviews	
	The student's capacity for thorough research, oral and written presentation, and the use of visual aids will be evaluated. Faculty members and peers present at the meeting make the evaluation	

**III SEMESTER
PATHOLOGY WITH MICROBIOLOGY**

CourseCode: MMLT-301(M)	MMLT-Semester-III Diagnostic Microbiology	L-4 T-0 P-2 C-5
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the etiologic characters, pathogenesis, lab diagnosis and treatment of Gram-positive bacteria.	
CO2	To classify the pathogenic role of Gram-negative bacteria and with special reference to their pathogenicity, Lab diagnosis and treatment.	
CO3	To categorize the pathogenic role of spirochetes with special reference to their pathogenicity, Lab diagnosis and treatment..	
CO4	To assess the significance of bacterial pathogens using serological diagnostic measures.	
CO5	To generalize the identification methods using antigen antibody techniques.	
CO6	To develop an understanding of molecular diagnostic methods.	
Course Content:		
Unit-1	Morphological features, Clinical manifestations & Lab diagnosis of Gram-positive bacteria: <i>Staphylococci, Pneumococci, Streptococci, Corynebacteria, Mycobacteria, Clostridia, Actinomycetes Bacillus Anaerobes.</i>	8 Hours
Unit-2	Morphological features, Clinical manifestations & Lab diagnosis of Gram negative bacteria: <i>Enterobacteriaceae, Pseudomonas, Vibria Brucella, Bordetella, Haemophilus, Yersinia, N. gonorrhoeae, N. meningitides.</i>	7 Hours
Unit-3	Morphological features, Clinical manifestations & Lab diagnosis of Spirochetes – <i>Treponema, Leptospira, Borrelia. Rickettsiae, Chlamydiae, Miscellaneous bacteria.</i>	6 Hours
Unit-4	Serological techniques for diagnosis: Immunoassays – ELISA, Immuno-electrophoresis, immuno- fluorescence, precipitation, flocculation and agglutination tests, rapid card methods; automatic blood culture system; rapid culture technique for MTB detection; micro-assays; laboratory techniques for cancer immunology.	8 Hours
Unit-5	Molecular Techniques for diagnosis: DNA recombinant techniques, PCR, NAT, nucleic acid amplification, plasmid analysis, fingerprinting, ribo-typing and DNA sequencing, probe amplification,	7 Hours

	and other advanced techniques.	
Text Books:	<ol style="list-style-type: none"> 1. Sastry and Bhat, 2021. <i>Essentials of Medical Microbiology</i>. Third Edition. Jaypee publishers. 2. Baweja, 2018. <i>Textbook of Microbiology</i>. Sixth Edition. Arya Publications 	
Reference Books	<ol style="list-style-type: none"> 1. Ananthanarayan and Paniker's. <i>Textbook of Microbiology</i>. Twelvth Edition. Orient Blackswan. 2. Greenwood, <i>Medical Microbiology</i>. Eighteenth Edition. Churchill Livingstone Elseiver. 	

CourseCode: MMLT-302(M)	MMLT-Semester-III Clinical Virology and Mycology	L-4 T-0 P-2 C-5
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the general characters of viruses with special emphasis on classification and its structure.	
CO2	To classify the pathogenic role of clinically important Virus with special reference to their diagnosis and treatment.	
CO3	To characterize the fungus on taxonomical basis, its cultivation and diagnosis.	
CO4	To assess the importance of systemic and opportunistic mycotic fungal pathogens.	
CO5	To generalize the serological identification methods for fungus.	
CO6	To compile the diagnostic assessment of subcutaneous fungal pathogens.	
Course Content:		
Unit-1	Introduction to Virology: The nature of viruses, Classification of viruses, structure of virus, Cultivation and replication of virus, Bacteriophage, Interferon, Viral vaccines and antiviral drugs, sample collection, transport and storage of sample for viral diagnosis.	8 Hours
Unit-2	General features, Multiplication Cycle, Diagnosis and Treatment of clinically important viruses: Rabies, Arbo viruses, hepatitis, HIV, viruses causing gastro enteritis, miscellaneous viruses, Pox virus, herpes virus, Myxoviruses, enteroviruses.	7 Hours
Unit-3	Introduction of Mycology, Characteristic of Fungi, Taxonomy of Fungi, Immunity to Fungal diseases, Fungal culture media, Fungal reagent and staining, Discuss the procedures used in properly collecting specimens for mycology; Diagnosis of fungal disease; Anti Fungal drugs.	6 Hours
Unit-4	Systemic and Opportunistic Mycoses: Histoplasmosis, Blastomycosis, Coccidioidomycosis and Paracoccidioidomycosis. Candidiasis,	8 Hours
Unit-5	Subcutaneous Mycoses: Mycetoma, Sporotrichosis, Chromoblastomycosis, Phaeohyphomycosis, Rhinosporidiosis and Lobomycosis.	7 Hours
Text Books:	<ol style="list-style-type: none"> Sastry and Bhat, 2021. <i>Essentials of Medical Microbiology</i>. Third Edition. Jaypee publishers. Baweja, 2018. <i>Textbook of Microbiology</i>. Sixth Edition. Arya 	

	Publications	
Reference Books	<ol style="list-style-type: none">3. Ananthanarayan and Paniker's. <i>Textbook of Microbiology</i>. Twelvth Edition. Orient Blackswan.4. Greenwood, <i>Medical Microbiology</i>. Eighteenth Edition. Churchill Livingstone Elseiver.	

Course Code: MMLT-303(M)	MMLT-Semester-III Epidemiology & Biostatistics	L-3 T-0 P-0 C-3
Course Outcomes:	On completion of the course, the students will be:	
CO1	To describe the epidemiology of the disease, its transmission and control.	
CO2	To discuss the importance of prevention and control of communicable and non-communicable diseases and interpretation of the epidemiological data.	
CO3	To present the published research including the need of screening tests, its accuracy and types of study design.	
CO4	To analyse the data using various statistical sampling methods.	
CO5	To evaluate the data using statistical interference methods	
CO6	To prepare a result out of the data using Anova.	
Course Content:		
Unit-1	Epidemiology - definition, concept and role in health and disease. Definition of the terms used in describing disease transmission and control. Modes of transmission and natural history of a disease Measures for prevention and control of communicable and non-communicable disease. Principal sources of epidemiological data	8 Hours
Unit-2	Definition, calculation and interpretation of the measures of frequency of diseases and mortality. Need and uses of screening tests. Accuracy and clinical value of diagnostic and screening tests (sensitivity, specificity, & predictive values). Causal Association & Various types of epidemiological study designs Critical evaluation of published research	7 Hours
Unit-3	Frequency distribution: diagrams, characteristics of a frequency distribution Basic distribution statistics: measures of central tendencies. Measures of variation/dispersions Confidence intervals. Measures of accuracy and precision Statistical sampling methods. Basic for statistical inference Sampling distribution Statistical inference. Statistical inference.	6 Hours
Unit-4	Type I and Type II errors. Parametric comparison of populations. The null hypothesis and statistical significance Comparison of means test including paired test One way analysis of variance (Anova).	8 Hours
Unit-5	Non Parametric distribution statistics Sign test Mann-whitney rank sum	7 Hours

	test X^2 (Chi Square) test. Linear regression and correlation Scatter diagram Correlation coefficient Regression coefficient Multiple regression. Sensitivity, specificity and predictive values Receiver – operating characteristics curve.	
Text Books:	1. Gupta. <i>Research Methodology</i> . Second Edition. International Book House Ltd.	
Reference Books	1. Kothari. <i>Research Methodology</i> . Fourth Edition. New Age International Publishers.	

CourseCode: MMLT-304(M)	MMLT-Semester-III Advanced Instrumentation Techniques	L-3 T-0 P-2 C-4
Course Outcomes:	On completion of the course, the students will be:	
CO1	To examine the study of Microbiological Instruments in Immunology.	
CO2	To define study of Microscope & its types.	
CO3	To develop an understanding of different analytical techniques.	
CO4	To explain recombinant DNA technology and related techniques.	
CO5	To apply different instrumental knowledge in the microbiological laboratory.	
CO6	To integrate microbiological instruments with isolation procedures.	
Course Content:		
Unit-1	Distillation plant, centrifuge Machine, Analytical Balance, Hotplate, Magnetic Stirrer, Water Bath, Automatic Dispensers and diluters, De-ionizer etc..	8 Hours
Unit-2	Study of compound microscope-magnifying, numerical aperture, resolution and components of microscope. Dark ground illumination care of microscope and common difficulties. Micrometry Study of phase contrast, interference, fluorescent an electron microscope. Preparation of smear for electron microscope,	7 Hours
Unit-3	Electrophoresis, Immunodiffusion, starplate, chromatography, ELISA reader, automatic washer and RIA equipment etc.	6 Hours
Unit-4	Recombinant DNA technology-PCR, western blotting, northern blotting and southern blotting.	8 Hours
Unit-5	Autoclave, Incubator, Hot air oven, Laminar Air flow, Colony Counter, Muffle furnace, Refrigerator, Incubator, Mac-Intos, intos field- jar etc freeze drying of bacteria	7 Hours
Text Books:	1. Text Book of Microbiology by Dr. C P Baveja VIII Edition 2. Text Book of Microbiology by Apurba S Sastry & Sandhya Bhat	
Reference Books	1. Prescott's Microbiology by Joanne Willey, Kathleen Sandman XI Edition	

	2. Essentials of Microbiology & Immunology by S K Mohanty & K Sai Leela & Dipti Pattanaik	
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Note: Course Out comes of following practical is covered in their respective theory course

Course Code: MMLT-301(M)P	MMLT- Semester-I Practical: Lab Course -1 (Based on Paper 1 & 2)	P-2 C-1
Course Content:		
1.	Introduction of Clinical specimen, identification of bacteria, staining methods Biochemical tests, antibiotic sensitivity testing.	
2.	Dark ground microscopy, special staining methods.	
3.	Air Sampling and theatre sterility.	
4.	Tissue culture methods.	
5.	Fluorescent microscopy,	
6.	To perform serological diagnosis using ELISA	
7.	To characterize the unknown pathogens using PCR	
8.	Identification of fungi from various clinical samples	
9.	Microscopic identification	
10.	Preservation of cultures	
11.	Special staining methods.	

Note: Experiments are subject to availability of chemicals/instruments.

Course Code: MMLT-302(M)P	MMLT- Semester-I Practical: Lab Course -2 (Based on Paper 3 & 4)	P-2 C-1
Course Content:		
1	Demonstration of spectrophotometer.	
2.	Separation of amino acids by paper chromatography	
3.	Separation of proteins by PAGE	
4.	Separation of DNA by Agarose Gel Electrophoresis	
5.	Demonstration of atomic absorption spectroscopy	
6.	Demonstration of western blotting.	
7.	Demonstration of flow cytometer	

Note: Experiments are subject to availability of chemicals/instruments.

<u>Course Code:</u> MMLT-303(M)P	MMLT-Semester-III Journal Club & Journal Reviews	
	The student's capacity for thorough research, oral and written presentation, and the use of visual aids will be evaluated. Faculty members and peers present at the meeting make the evaluation	

IV SEMESTER

Course Code: MMLT-401D	MMLT-Semester-IV	
	Dessertation	