काशी हिन्दू विश्वविद्यालय

BANARAS HINDU UNIVERSITY

DDU KAUSHAL KENDRA CURRICULUM

For

MASTER of VOCATION (M. Voc.)

DEGREE PROGRAMME

in

MEDICAL LABORATORY TECHNOLOGY

(Effective from July 2019-20)

Master of Vocation – Medical Laboratory Technology

(2 years – Four Semester Full Time Course)

DEEN DAYAL UPADHYAY KAUSHAL KENDRAs:

(XII plan guidelines for Deen Dayal Upadhyay Centres for knowledge acquisition and up gradation of skilled human abilities and livelihood (KAUSHAL) in universities and colleges - 2014 - 2017)

Introduction:

Education plays an important role in the overall development of a human being as well as the nation. It is a unique investment in the present and for the future. Every country develops its own system of education to express and promote its unique socio-cultural identity besides meeting the challenges of time to leverage the existing potential opportunities. India, at present, is recognized as one of the youngest nations of the world with over 50% of population under the age of 30 years. It is estimated that by 2025, India will have 25% of the world's total workforce. In order to harness the full demographic dividend, India needs high quality educational system which is affordable, flexible and relevant to the individuals, as well as to needs of the society as a whole. Today, the country faces a demand – supply mismatch as the economy needs more 'skilled' workforce as also the managers and entrepreneurs than produced annually. In fact, majority of the contemporary institutions of higher learning remain almost disconnected with the requirements of the workplace. The higher education system has to incorporate the requirements of various industries in its curriculum, in an innovative and flexible manner while producing well groomed graduates. UGC introduced two schemes known as – Community Colleges and B.Voc. Degree Program in universities and colleges during the XII Plan. However, there is a need for taking integrated initiatives towards knowledge acquisition and up-gradation of skilled human competencies in universities and colleges to address the emerging needs of the economy so as to ensure that the graduates have adequate knowledge and skills to get appropriately employed or become entrepreneurs and, thereby, meet the economic and industrial needs at the regional and national level. Government of India, taking note of the requirement for skill development among students

developed National Vocational Education Qualification Framework (NVEQF) which was later on assimilated into National Skills Qualifications Framework (NSQF). Various Sector Skill Councils (SSCs) are developing Qualification Packs (QPs), National Occupational Standards (NOSs) and assessment mechanisms in their respective domains, in alignment with the needs of the industry.

In view of this, the UGC implemented the scheme of Community Colleges from 2013-14 in pilot mode on the initiative of the MHRD. However, realizing the importance and the necessity for developing skills among students, and creating work ready manpower on large scale, the Commission decided to implement the scheme of Community Colleges as one of its independent schemes from the year 2014-15. The Commission also launched another Scheme of B.Voc. Degree program to expand the scope of vocational education and also to provide vertical mobility to the students admitted into Community Colleges for Diploma programs to a degree program in the Universities and Colleges. While these two schemes are being implemented, it is also realized that there is a need to give further push to vocational education on a even larger scale. It is therefore proposed to establish as many as 100 'Deen Dayal Upadhyay Centres for Knowledge Acquisition and Up gradation of Skilled Human Abilities and Livelihood (KAUSHAL)' during the XII Plan period. These Centers would take-up the vocational education to new levels and offer courses beyond B.Voc. Degree also. These Centres would also embed and follow the guiding principles of NSQF, QPs, and NOSs for their programs and would not focus on skilling alone but also develop entrepreneurship traits. The Centres may endeavor to maintain a paramedical structure of student enrolment with respect to Diploma, Advanced Diploma, B.Voc. and further studies.

Objectives of the Scheme:

The main objectives of these centres are to:

a) Create skilled manpower for industry requirements at various levels. The scheme provides for vertical mobility from short term MLT certificate courses to full-fledged post graduate degree program, and further research in specialized areas. The courses would be planned/ designed to have provision of multiple entry and exit at various levels culminating up-to a research degree level. These shall also include courses which are offered under the Community College Scheme and B.Voc. degree program

of UGC.

b) Formulate courses at postgraduate level keeping in mind the need of i) Industry in specialized areas; ii) Instructional design, curriculum design and contents in the areas of Skills Development; iii) Pedagogy, assessment for skills development education and training; iv) trained faculty in the areas of skill development; and v) Entrepreneurship; etc.

c) Work for coordination between the higher education system and industry to become a Centre of Excellence for skill development in specialized areas.

d) Network with other such centers and universities and colleges imparting vocational education under the scheme of Community Colleges and B.Voc degree program in their region and coordinate with them for targeted development of skill oriented education.

e) Undertake R&D in the areas related to skill education & development, entrepreneurship, employability, labour market trends etc. at the post-graduate and research level.

f) Act as finishing school by providing supplementary modular training programs so that a learner, irrespective of his/her training background, is made job ready with necessary work skills (soft, communication, ICT skills etc) and fill the gaps in the domain skills measured against QPs/NOSs.

g) Provide for Recognition of Prior Learning (RPL) framework for job roles at NSQF Level4 onwards by conducting assessment and certification with respective Sector Skill Councils (SSCs) / Directorate General of Employment and Training (DGET).

h) Maintain 'Labour Market Information' for respective regions in coordination with other government agencies and industry associations.

i) Develop and aggregate curriculum, content and learning materials for skills development in different sectors.

Basic Principles for Curriculum Design:

While formulating the curriculum under the scheme, the Centers may:

- Follow credit based semester system;
- Provide for provision for credit transfer across courses;
- Ensure alignment of skill component with the QPs/NOSs of the relevant job roles based on the exit profiles of the students. The focus of skill development components should be to equip students with appropriate knowledge, practice and attitude, so as to make them work ready. The skill development components should be relevant to the industries as

per their requirements;

- Provide credits for practical work, apprenticeship, on the job training, and project work;

e) Provide multiple exit and entry points with provision for vertical and horizontal mobility;

f) Assess and certify the skill competence for the selected job roles through the respective SSCs / DGET;

g) Provide credits for general education component and skill component broadly in the ratio of 40: 60. The general education will also include credits in communication skills, ICT skills, soft skills, critical thinking, problem solving, environmental studies and value education.

h) Review the courses periodically in accordance with the changing requirements of the industry and regional / national economic priorities.

i) Follow UGC guidelines for skill development courses at different levels specified under Community Colleges, B.Voc. degree program and as may be prescribed from time to time.

Programs and Curricula:

(UGC guidelines for curricular aspects, assessment criteria and credit system in skill based vocational courses under national skills qualification framework (NSQF) In order to make education relevant and to create 'industry fit' skilled workforce, the institutions recognized under Community Colleges / B.Voc Degree program, and Deen Dayal Upadhyay KAUSHAL Kendras offering skill based courses will have to be in constant dialogue with the industry and respective Sector Skill Council(s) so that they remain updated on the requirements of the workforce for the local economy. There will be credit-based modular programs, wherein banking of credits for skill and general education components shall be permitted so as to enable multiple exit and entry. This would enable the learner to seek employment after any level of Award and join back as and when feasible to upgrade her / his qualification / skill competency either to move higher in her / his job or in the higher educational system. This will also provide the learner an opportunity for vertical mobility to second year of B.Voc degree program after one year diploma and to third year of B.Voc degree program after a two year advanced diploma. The students may further move to masters and research degree programs (NSQF Level 8 – 10)

O.S. M.Voc.-Medical Laboratory Technology– 1:

Admission Eligibility: There may be three types of learners getting admission to first semester of skill based courses under NSQF:

Category – 1 : students already acquired NSQF certification Level 7 in a particular industry

sector and opted admission in the skill based courses under NSQF in the institutions recognized under Community Colleges / B.Voc Degree program / DDU KAUSHAL Kendras in same trade with job role for which he / she was previously certified.

Category – 2 : students who have acquired NSQF certification Level 7 but may like to change their trade and may enter into skill based courses in a different trade(candidate has to take up Skill Bridge course during semester I/II).

Category – 3: Any Graduate with at least 50% Marks from any recognized University. Candidate who have passed an equivalent examination from any other University or examining body and is seeking admission to the M.Voc.-Medical Laboratory Technology course will be required to provide necessary eligibility certificate.

O.S. M.Voc.-Medical Laboratory Technology– 2:

The duration of the course will be of two full time academic years. No candidate will be allowed to join any other course or service simultaneously. The examination for the Master of Vocation – Medical Laboratory Technology (M.Voc.- Medical Laboratory Technology) course will be divided into four semesters.

Multi-level Exit:

Candidate will be eligible to receive PG Diploma (NSQF Level 8) after first 2 semesters according to guidelines of UGC.

O.S. M.Voc.-Medical Laboratory Technology– 3:

Subject to the provisions laid down in Ordinance **O.S. M.Voc.-Medical Laboratory Technology– 2**, a candidate who has passed the M. Voc. semester I & II of this University and if there is a break in the studies for any reason and if there is a change in the courses from semester system to annual part Examination system, the candidate will be admitted to M. Voc. Part II and the marks/ credits obtained by the candidate in his previous examination of this University in M. Voc. semester I and II will be carried forward and the result of the M. Voc. Final Examination will be declared accordingly.

O.S. M.Voc.-Medical Laboratory Technology– 4:

To pass the whole M. Voc. Examination, student should clear M. Voc. Semesters I to IV and examinations within a period of four years from the date of his/her registration. Failing to this He /She will be required to register himself as a fresh candidate and keep the attendance and appear and pass all semester examinations afresh from first onwards in order to obtain the Degree of Master of Vocation.

O.S. M.Voc.-Medical Laboratory Technology– 5:

No candidate will be admitted to any semester examination for M.Voc.-Medical Laboratory Technology (M.Voc.-Medical Laboratory Technology) unless a student has put on at least 80% of the total lecture periods and practical periods in each subject in each semester.

O.S. M.Voc.-Medical Laboratory Technology– 6:

No candidate will be admitted to reappear at any semester examination, which he has already passed. The marks of successfully completed paper will be carrying forwarded for the award of class.

O.S. M.Voc.-Medical Laboratory Technology– 7:

There shall be an examination at the end of each semester to be known as Pre PG Diploma (first semester) examination, PG Diploma (second semester-NSQF Level-8) examination, Pre M.Voc. Degree (third semester) examination and M.Voc. Degree (fourth semester-NSQF Level-9) examination. At which a student shall appear in that portion of theory papers, practical and viva – voice if any, for which he has kept the semester in accordance with the regulations in this behalf.

M.Voc. Medical Laboratory Technology

Name of the Program(s) (Diploma, Adv. Diploma, Degree)	Semesters	No. of Credits **30 Cr./Sem**	Job Roles and **NSQF**-Levels
B. Voc. (Hons.) **OR** PG Diploma in Medical Laboratory Technology	1 2	60 Credits	**NSQF Level 6** Hons / PG Dip
M.Voc. in Medical Laboratory Technology	3 4	60 Credits	**NSQF Level 7** M.Voc. Master

Masters of Vocation (Medical Laboratory Technology)
M. Voc. (MLT)
First Year

Semester I

Course Code	Component	Unit	Topic	Credits	L /Week	Marks	
						Internal (Theory)	External (Theory)
MMLT101 (Human Anatomy & Physiology)	General	I	Human Anatomy I	04	01	**30**	**70**
	General	II	Human Anatomy II		01		
	General	III	Human Physiology I		01		
	General	IV	Human Physiology II		01		
MMLT102 (Hematology & Pathophysiology)	Skill	I	Hematology I	06	02	**30**	**70**
	Skill	II	Hematology II		01		
	Skill	III	Pathophysiology I		02		
	Skill	IV	Pathophysiology II		01		
						30	**70**
MMLT103 (Pharmacology & Pharmacokinetics)	General	I	Pharmacology I	02	01		
	General	II	Pharmacology II				
	General	III	Pharmacokinetics I		01		
	General	IV	Pharmacokinetics II				
MMLT104 (Medical Microbiology)	Skill	I	Introduction of Microbiology	06	02	**30**	**70**
	Skill	II	General Microbiology		01		
	Skill	II I	Medical Microbiology		02		
	Skill	IV	Industrial Microbiology		01		
MMLT105 Elective: 1	Skill	I	Basics	06	02	**30**	**70**
	Skill	II	Principal		01		
	Skill	III	Instrumentation		02		
	Skill	IV	Medical implication		01		
MMLTP106			Practical's of Course Hematology	2	02		**100**
MMLTP107			Practical's of Course Pharmacology & Pharmacokinetics	2	02		**100**
MMLTP108			Practical's of Course Medical Microbiology	2	02		**100**
Total Credits				**30**			

MMLT105 Elective: 1 Student opt any one in given below;

Elective: 1, MMLT105 (i): Biochemistry
Elective: 1, MMLT105 (ii): Immunology
Elective: 1, MMLT105 (iii): **Bio transport Process**
Elective: 1, MMLT105 (iv): **Electrophysiological Signal Analysis**

****Job Role: Patient Relations Associate (NSQF Level 5)**

Masters of Vocation (Medical Laboratory Technology)

M. Voc. (MLT)

First Year

Semester II

Course Code	Component	Unit	Topic	Credits	L /Week	Marks	
						Internal (Theory)	External (Theory)
MMLT201 (Biomedical Engineering and Technology)	**Skill**	**I**	Understanding of physiological system	06	0	**30**	**70**
	Skill	**II**	Bioinstrumentation		0		
	Skill	**III**	Biomechanics		0		
	Skill	**IV**	Computer applications in biomedical Engineering		0 1		
MMLT202 (Molecular Biology & Recombinant DNA Technology)	**Skill**	**I**	Fundamentals of Molecular Biology	06	0	**30**	**70**
	Skill	**II**	Transcription and Translation		0		
	Skill	**III**	Gene genomics & Mutation		0		
	Skill	**IV**	Recombinant DNA Technology		0 1		
MMLT203 (Molecular & Human Genetics)	**General**	**I**	Basic Human Genetics	04	0	**30**	**70**
	General	**II**	Molecular Genetics I		0		
	General	**III**	Molecular Genetics I Cytogenetics		0		
	General	**IV**	Disorders & Clinical Genetics		0		
MMLT204 (Laboratory Management and Biostatistics)	**General**	**I**	Laboratory Management I	04	0	**30**	**70**
	General	**II**	Laboratory Management II		0 1		
	General	**III**	Biostatistics I		0		
	General	**IV**	Biostatistics II		01		
MMLT205 Elective 2	**Skill**	**I**	Basics	06	0	**30**	**70**
	Skill	**II**	Principal		0		
	Skill	**III**	Instrumentation		0		
	Skill	**IV**	Medical implication		0		
MMLTP206			Practical's of Course Biomedical Engineering and Technology	2	02		**100**
MMLTP207			Practical's of Course Molecular Biology & Recombinant DNA Technology	2	02		**100**
			Total Credits	**30**			

MMLT205 Elective 2 Student opt any one in given below;

MMLT205 Elective 2 (i): Biomaterials
MMLT205 Elective 2 (ii): Biological System Analysis and Control
MMLT205 Elective 2(iii): Composite Materials
MMLT205 Elective 2(iv): Biomedical Signal and Image Processing

*Hospital training /on job Training:

***Job Role Assistant Duty Manager – Patient Relation Services (NSQF Level 6)**

Masters of Vocation (Medical Laboratory Technology)

M. Voc. (MLT)

Second Year

Semester III

Course Code	Component	Unit	Topic	Credits	L /Week	Marks	
						Internal (Theory)	External (Theory)
MMLT1301 (Histopathology and Cytopathology)	Skill	I	Histopathology I	06	02	30	70
	Skill	I	Histopathology II		01		
	Skill	II I	Cytopathology I		02		
	Skill	I V	Cytopathology I		01		
MMLT302 (Medical Parasitology)	Skill	I	General Parasitology	06	02	30	70
	Skill	I	Diagnostic Parasitology		01		
	Skill	II I	Mycology		02		
	Skill	IV	Diagnostic Mycology		01		
MMLT303 Elective 3	Skill	I	Basics	04	01	30	70
	Skill	I	Principal		01		
	Skill	I	Instrumentation		01		
	Skill	IV	Medical implication		01		
MMLT304 Dissertation / Project	Skill	I	Sample collection & Segregation	10	03		600
	Skill	I	Biomedical Coding		02		
	Skill	II	Instrument handling		03		
	Skill	I	Report drafting and submission		02		
MMLT305 (Seminar)	General	I	Problem Search	04	01		200
	General	I	Hypothesis generation		01		
	General	II	Work plan		01		
	General	I	Presentation &Teaching ability		01		
Total Credits				30			

Elective 3: Student opt any one in given below;

MMLT303: Elective 3 (i) : Research Methodology in Health sector
MMLT303: **Elective 3 (ii)** : Effects of Radiation and Biomedical Applications of Radiation
MMLT303: **Elective 3 (iii)** : Bio ceramics

***Job Role Assistant Duty Manager – Patient Relation Services (NSQF Level 6)**

Masters of Vocation (Medical Laboratory Technology)
M. Voc. (MLT)
Second Year
Semester IV

Course Code	Component	Unit	Topic	Credits	L /Week	Marks	
						Internal (Theory)	External (Theory)
MMLT401 (Non-invasive Techniques)	**Skill**	**I**	Non-invasive Techniques I	**06**	**02**	**30**	**70**
	Skill	**I**	Non-invasive Techniques II		**01**		
	Skill	**II**	Non-invasive Techniques III		**02**		
	Skill	**IV**	Non-invasive Techniques III		**01**		
MMLT402 (Bioinformatics and Medical Transcription)	**Skill**	**I**	Bioinformatics I	**06**	**02**	**30**	**70**
	Skill	**I**	Bioinformatics II		**01**		
	Skill	**II**	Medical Transcription I		**02**		
	Skill	**IV**	Medical Transcription II		**01**		
MMLT403 Elective 4	**Skill**	**I**	Basics	**06**	02	**30**	**70**
	Skill	**I**	Principal		01		
	Skill	**I**	Instrumentation		02		
	Skill	**IV**	Medical implication		01		
MMLT404 Dissertation / Project	**Skill**	**I**	**Thesis Submission**	**10**	03		**600**
	Skill	**I**	Skill performance		02		
	Skill	**II**	Quality control / quality		03		
	Skill	**I**	Viva		02		
MMLT405 (Seminar)	**General**	**I**	Problem Search	**06**	02		**200**
	General	**I**	Hypothesis generation		01		
	General	**II**	Work plan		02		
	General	**I**	Presentation &Teaching ability		01		
Total Credits				**30**			

MMLT403 Elective 4: Student opt any one specialization in given below;

I. Medical Histology (Job Role: Duty Manager Histology)
II. Medical Cytology (Job Role: Duty Manager Cytology)
III. Blood Bank (Job Role: Blood Bank Duty Manager)
IV. Medical Genetics (Genetic Counseling) (Job Role: Genetic Counselor)
V. Molecular Diagnosis (Job Role: Duty Manager – Molecular Diagnosis)
VI. Immunodiagnostics (Duty Manager – Immunodiagnosis)

Job Role: Duty Manager – Patient Relation Services (NSQF Level 7)

Masters of Vocation (Medical Laboratory Technology)
M. Voc. (MLT) Syllabus

First Year
Semester I
(Skill Component)

Human Anatomy and Physiology (MMLT101)

Course Code	Title	Credits	NOS
MMLT101	**Basics of Human Anatomy-I**	**04**	
Unit I	Introduction to: Anatomy, cells, tissues and organ systems		
	Integumentary System skin, hair, nails, covers the body; regulates body temp; creates structures for sensation.		
	Skeletal System basic framework of the body protects & supports Structure of bones, joints, cartilage types of bones, Bones of cranium, face vertebral column upper and lower limbs.		
	Basics of Human Anatomy-II		
Unit II	**Muscular System**: skeletal muscles attach to bones; maintains posture; helps us move		
	Basics of Physiology- I		
Unit III	**Digestive Systems:** Digestion of food in mouth, stomach & small intestines. Absorption of food, function of accessory digestive gland liver, pancreas and gallbladder.		
	Lymphatic System: lymph nodes, lymphatic vessels, lymph & other lymphoid organs, fluid balance.		
	Immune System: Defense system; defense against pathogens & other foreign material (allergens) & our own cells that have gone awry.		
	B**asics of Human Physiology-II**		
Unit IV	**Respiratory System**: Parts of Respiratory System, Lungs, Function of lungs & other structures that carry/conduct air to & fro from lungs. Respiration disorders like anoxia, dyspnea. (Theory) lung function tests.(theory)		
	Excretory Systems: Renal: Structure & function of kidney and disorders of kidney. **Urinary:** Mechanism of urine formation urinary bladder.		
	Reproductive Systems: Physiology of Male & female reproductive organs (name, structure &function)		

Hematology & Pathophysiology (MMLT102)

Course Code	Title	Credits	NOS
MMLT102	**Hematology I**	**03**	
Unit I	Haematopoesis – Origin, development, function and fate of blood cells. Erythropoiesis – Origin, development of RBCs, biosynthesis of Hb, control of Erythropoiesis, Disorders of Red blood cells & Erythrocyte Indices Anaemia, Classification and clinical features. Investigations in a case of anaemia. Morphologic – Microcytic, hypochromic anaemia, macrocytic anaemia. Haemolytic anaemia. Aplastic anemia. Pancytopenia, Anemia due to abnormal globin synthesis.		
	Hematology II		
Unit II	Disorders of white Blood cells: Leucocytosis, Leukopenia, Leukaemoid reaction, Myelo dysplastic syndrome (MDS). Leukaemias, Plasma cell disorders, Myelo Proliferative disorders, Lympho Proliferative disorders, Haemorrhagic disorders, Vascular disorders, Platelet disorders, coagulation disorders & Fibrinolysis.		
	Pathophysiology I	**03**	
Unit III	Disorders of circulation: Thrombosis, Embolism, Infarction, Oedema, Congestion. Mechanism and changes in inflammation. Study of tumors Characteristics Classification etiology & Pathogenesis.		
	Pathophysiology II		
Unit IV	Collection, transport, preservation and processing of various clinical specimens. Physical, chemical and microscopic examination of Urine, Sputum, Gastric fluid, Cerebrospinal fluid, Semen and Stool		

Pharmacology & Pharmacokinetics (MMLT103)

Course Code	Title	Credits	NOS
MMLT103	**Pharmacology I**	**01**	
Unit I	General Pharmacological Principles, Routes of Drug Administration Receptor Pharmacology Aspects of Pharmacotherapy, Clinical Pharmacology and Drug Development Adverse Drug Effects, Drugs Acting on Autonomic Nervous System, Autacoids and Related Drugs, Respiratory System Drugs , Hormones and Related Drugs , Drugs Acting on Peripheral (Somatic) Nervous System , Drugs Acting on Central Nervous System ,		
	Pharmacology II		
Unit II	Cardiovascular Drugs , Drugs Acting on Kidney , Drugs Affecting Blood and Blood Formation , Gastrointestinal Drugs , Antimicrobial Drugs ,Chemotherapy of Neoplastic Diseases		
	Pharmacokinetics I	**01**	
Unit III	Pharmacokinetics: Pharmacokinetic Tools, Distribution Phenomenon, Membrane Transport, Absorption and Distribution of Drugs		
	Pharmacokinetics: Metabolism and Excretion of Drugs, Kinetics of Elimination, Clearance Concepts, Pharmacodynamics: Mechanism of Drug Action.		
	Pharmacokinetics II		
Unit IV	Intravenous Bolus, Extravascular Administration, Intravenous Infusion, Multiple Dosing, Hepatic Clearance Renal Clearance, Metabolite Kinetics Multi-Compartment Models, Nonlinear Pharmacokinetics.		

Medical Microbiology (MMLT104)

Course Code	Title	Credits	NOS
MMLT104	**Introduction of Microbiology**	**06**	
Unit I	History, development, scope & applications of Microbiology. Classification of microorganism – Prokaryotes and Eukaryotes. Microscopic examination of micro-organism (Bright field microscopy, dark field microscopy, phase contrast microscopy, electron microscopy). Morphology of bacteria – size, shape and arrangement of bacterial cell – cell wall, cytoplasmic membrane, flagella, fimbriae and pili, cytoplasmic matrix, nucleoid, cytoplasmic inclusions. Bacterial growth curve, growth requirements Bacterial genetics- methods of gene transfer – Transformation-mechanism, natural and artificial, Transduction-mechanism, generalized and specialized transduction, lysogenic conversion, Conjugation-Properties of F-plasmid, HFr strains, col factor.		
	General Microbiology		
Unit II	Staining of microbes & theory of staining (Stains –simple stains, negative stain, grams, differential and special stains. Sterilization and disinfection (physical & Chemical)		
	Medical Microbiology		
Unit III	Distribution and occurrence of normal bacterial flora of human body of Skin, Eye, Respiratory Tract, Mouth, Intestinal Tract & Genitourinary Tract. Methods of Microbiology isolation of pure cultures (streak culture, Pour plate culture, Stab culture, Anaerobic culture methods), colony count Disease oriented microbiology, culture & sensitivity test, aerobic, anaerobic techniques Laboratory identification of infectious agents, Antimicrobial susceptibility test. IMViC, Urease, catalase, geletine liquification, coagulase, oxidase, sugar fermentation, antibiotic sensitivity test. Introduction to Fungi and parasitic fungi, specimen collection, Laboratory diagnosis of mycotic infections, Diagnostic mycology Introduction, Protozoa, Helminths, Medical Entomology Gram positive - streptococcus, staphylococcus, bacillus, mycobacterium, corynebacterium, Gram negative - E-coli, Klebsiella, Salmonella, shingela, Vibrio, Pseudomonas		
	Industrial Microbiology		
Unit IV	Antibacterial antibiotics and their mode of action. Recombinant DNA technology, genetic engineering and gene cloning in micro- organisms. Automation in microbiology, Quality control in clinical microbiology laboratory. Development of chemotherapy, General characteristics of antimicrobial drugs, Determining level of antimicrobial activity, Mechanism of action of antimicrobial agents, factors influencing the effectiveness of antimicrobial drugs, Antibacterial drugs viz. sulfonamides, Quinolones, Penicillins, Cephalosporins, Tetracyclines, Erythromycin, Chloramphenicol, Drug Resistance, Antifungal, Antiviral drugs and Vaccines.		

Elective: 1-MMLT105

Elective: 1, MMLT105 (i): Biochemistry

Course Code	Title	Credits	NOS
MMLT105 (i)	**Biochemistry**	**06**	
	Basics		
UNIT I	Introduction to Bio-chemistry. Water as a biological solvent. Dissociation of water. Buffer solution. Henderson Hasselbalch equation.		
UNIT II	**Structure, Functions and Classification of Carbohydrates**		
	Carbohydrates : Definition and classification of carbohydrates. Fischer and Haworth structures of carbohydrates. Stereoisomerism, and muta-rotation. Anomeric forms of monosaccharides. Derivatives of monosaccharides (glycosides, deoxysugars, amino sugars and other derivatives of biological importance). Oligosaccharides (structure of maltose, lactose, sucrose, cellobiose, trehalose, raffinose). Characteristic reactions of monosaccharides : Reactions with hydrazine, hydrogen cyanide, hydroxylamine; reduction and oxidation of sugars; periodic acid oxidation; action of alkali upon sugars; acylation and methylation of sugars. Homo-and hetero-polysaccharides (structures of amylose, amylopectin, starch, inulin, pectins, dextrins, glycogen, cellulose, chitin).		
UNIT III	**Structure, Functions and Classification of Lipids**		
	Lipids :Definition and classification of fatty acids (saturated and unsaturated). Essential fatty acids. Important reactions of functional groups present in fatty acids. Characteristics of fatty acids and fats (saponification, iodine, acid, acetyl and peroxide values). Refractive index, m. p., b. p. and their relation to molecular size. Properties of glycerol. Fats as source of energy. Waxes. Structures, characteristics and functions of lipids : Triacylglycerols, phospholipids : lecithins (Phosphotidyl Cholines), lysolecithins, cephalins (Phosphotidyl ethanolamines), Phosphatidyl serines, phosphatidyl inositol, sphingomyelins, plasmalogens), cerebrosides, gangliosides,n sulfatides. Lipoproteins—Composition, classification and biological.		
UNIT IV	**Structure, Functions and Classification of Amino Acids and Proteins**		
	Structural and functional diversity of proteins, fibrous proteins (keratins, collagen & elastin), globular proteins (hemoglobin, myoglobin) and conjugated proteins. Levels of protein structure. Amino Acids: Common structural features. Stereoisomerism and RS system of designating optical isomers. Classification based on the nature of "R" groups. Amino acids present in proteins and non-protein amino acids. Specialized role of amino acids. Physical and Chemical properties of amino acids. Titration of amino acids. Peptide Bonds: Rigid and planar nature of a peptide bond. Folding of peptide chains into regular repeating structures (helix, pleated sheets).		

Elective: 1, MMLT105(ii): Immunology

Course Code	Title	Credits	NOS
MMLT105(ii)	**Immunology**	**06**	
UNIT I	**Introduction to Immunology**		
	Introduction and history of Immunology, Non- specific Defense; Physical Barriers, Chemical Barriers, Phagocytosis, Inflammation, Fever, Types of Immunity, Active & Passive Immunity, Immunological memory, Primary & Secondary Lymphoid organs, Mucosa Associated Lymphoid tissue (MALT), Cutaneous Associated Lymphoid Tissue (CALT), Lymphocyte Traffic, Cells of immune system, Antigens; factors affecting Immunogenicity, epitopes, haptens.		
UNIT II	**Humoral Immunity**		
	Humoral Immune Response, Antibodies / Immunoglobulins, Structure, function and type of antibodies, Antigentic-combining regions of antibodies, factors influencing antibody production, Genetic model, Multigene Organisation, generation of antibody diversity.		
	Cell Mediated Immunity		
UNIT III	Cell Mediated Immune System, Mechanism of CMI, Types of effector T Cells, Helper T-cells, Suppressor, T-cells, cytotoxic T cells, Killer T cells, Cytokines, Lymphokines, Colony Stimulating factors, Tumour Necrosis factor, Interferons, Accessory cells (Macrophages), the Complement System, Classical and Alternate pathway, HLA, Monoclonal antibody technology and its applications, Interactions between B and T lymphocytes.		
	Antigen-Antibody Interactions		
UNIT IV	Antigen-Antibody Interactions : Precipitation reaction, Immuno-diffusion test, counter current Immuno electrophoresis, complement fixation tests, Widal test, Wasserman's test, Weil Felix reaction, Western Blotting, Types of vaccines.		

Elective: 1, MMLT105(iii): Bio transport Process

Course Code	Title	Credits	NOS
MMLT105(iii)	**Bio transport Process**	**06**	
Unit I	Introduction to fluid flow, heat transfer and mass transfer.		
Unit II	Unified approach of momentum; Heat and Mass transfer; flowbehaviors of Newtonian and non-Newtonian fluids;		
Unit III	application of momentum; heat and mass transfer principles of biological system with particular emphasis on human beings; fluid mechanics of time dependent flows in pulmonary and urinary systems; Engineering models and their utilization in describing in-vivo observations.		
Unit IV	Modeling of the body as compartment; Source and stream; heat exchange between human body and its environment; mass transfer in membrane; heamodialysis as related to artificial kidney; extra corporal oxygenerators		

Elective: 1, MMLT105(iv): Electrophysiological Signal Analysis

Course Code	Title	Credits	NOS
MMLT105(iv)	**Electrophysiological Signal Analysis**	**06**	
Unit I	Introduction to bioelectric phenomena. Generation, transmission and interaction of signals in nervous systems. Discussion of initiation and propagation of action potential along nerve fibers.		
Unit II	Voltage clamp experiments. Synaptic transmission and transduction process in receptors.		
Unit III	Frequency modulation of the electrical signals. Use of mathematical models particularly electrical circuit models in describing behavior of cell membranes. fluid mechanics of time dependent flows in pulmonary and urinary systems; Engineering models and their utilization in describing in-vivo observations.		
Unit IV	Generation, propagation, characteristics and recording of ECG, EEG, EMG, EOG, ERG and evoked potentials. Neural control mechanism. Mass transfer in membrane; heamodialysis as related to artificial kidney; extra corporal oxygenerators		

MMLTP106: Practical's of Course Hematology & Pathophysiology

MMLTP106	Practical's of Course Hematology & Pathophysiology	02	NOS
1.	Blood collection. Anticoagulants used in Hematology		
2.	Preparation of blood smear and staining		
3.	Determination of haemoglobin concentration by sahil's method /cyanmeth method		
4.	Determination of total erythrocyte(RBC) count		
5.	Determination of leukocyte (WBC) count		
6.	Determination of pack cell volume (PCV)/ erythrocyte sedimentation rate (ESR)		
7.	Determination and calculation of red blood indices MCH,MCH,MCHC		
8.	Study of differential leukocyte count		
9.	Determination of absolute Eosinoehil count		
10.	Determination of platelet count / reticulocyte count.		
11.	Determination of prothrombin time/ bleeding time		
12.	Determination of blood clotting time 1.capillary method 2.tube method		
13.	Qualitative test /Qualitative test for ABO grouping & D(Rho) antigen with antisera by slide method / tube method		
14.	To perform cross matching test by saline-tube method		
15.	To perform direct Coomb's test		

MMLTP107 Practical's of Course of Pharmacology & Pharmacokinetics

MMLTP107	**Practical's of Course Pharmacology & Pharmacokinetics**	**02**	
1.	Animal ethics & Ethical Guideline		
2.	Good laboratory practice		
3.	Prescription writing		
4.	Animal handling		
5.	Collection of blood from experimental animal		
6.	Calculation of drug dosage and percentage solutions		
7.	Study of action of drugs on the rabbit's eye		
8.	Demonstration of common dosage forms		
9.	Effect of drugs on Animal's blood pressure		
10.	Effect of drugs on Animal's respiration		
11.	Evaluation of analgesics by chemical method		
12.	Study of action of antidepressants on mice		
13.	Randomized Controlled Clinical trials		
14.	General principles of antimicrobial use		
15.	Sample form for informed consent		

MMLTP108 Practical's of Course Medical Microbiology

MMLTP108	Practical's of Course Medical Microbiology	02	
1.	Preparation of different culture media and Biochemical media. Culture techniques		
2.	Isolation of bacteria on Nutrient agar, Blood Agar, Maconky agar		
3.	Preparation of smear and Staining techniques-Gram stain, Acid fast stain, Albert stain		
4.	Identification of organism from clinical sample (CSF, Pus, Urine, Stool).		
5.	Demonstration of bacterial motility by hanging drop preparation		
6.	Antibiotic sensitivity test from stalk culture or biological specimen using commercial plates and discs		
7.	To perform biochemical test 1.IMVic test 2.Catalase test 3.Coagulase test 4.Oxidase test 5.Gelatin liquefaction test 6.Urease test		
8.	To perform Sugar fermentation test.		
9.	Identification of ova/cyst from given stool sample. 1.Iodine preparation 2.Saline preparation		
10.	Identification of malarial parasite by using blood smear.		
11.	To perform WIDAL test-by tube method or slide method		
12.	To perform VDRL test/RPR		
13.	To perform RA test by latex agglutination		
14.	Urine examination, Physical, chemical and microscopic. Urine		
15.	Sputum examination - Microscopic and AFB Staining and eosinophil's		

MASTERS OF VOCATION (MEDICAL LABORATORY TECHNOLOGY)
M. Voc. (MLT)
First Year
Semester II

Course Code	Component	Unit	Topic	Credits	L /Week
MMLT201 (Biomedical Engineering and Technology)	**Skill**	**I**	Understanding of physiological system	06	02
	Skill	**II**	Bioinstrumentation		01
	Skill	**III**	Biomechanics		02
	Skill	**IV**	Computer applications in biomedical engineering		01
MMLT202 (Molecular Biology & Recombinant DNA Technology)	**Skill**	**I**	Fundamentals of Molecular Biology	06	02
	Skill	**II**	Transcription and Translation		01
	Skill	**III**	Gene, Genomics & Mutation		02
	Skill	**IV**	Recombinant DNA Technology		01
MMLT203 (Molecular & Human Genetics)	**General**	**I**	Basic Human Genetics	04	01
	General	**II**	Molecular Genetics		01
	General	**III**	Cytogenetics		01
	General	**IV**	Clinical Genetics & Disorders		01
MMLT204 (Laboratory Management and Biostatistics)	**General**	**I**	Laboratory Management I	04	01
	General	**II**	Laboratory Management II		01
	General	**III**	Biostatistics I		01
	General	**IV**	Biostatistics II		01
MMLT205 Elective 2	**Skill**	**I**	Basics	06	02
	Skill	**II**	Principal		01
	Skill	**III**	Instrumentation		02
	Skill	**IV**	Medical implication		01
MMLTP206			Practical's of Biomedical Engineering and Technology	2	02
MMLTP207			Practical's of Molecular Biology & Recombinant DNA Technology	2	02
			Total Credits	**30**	

****MMLT205 Elective 2:** Student opt any one in given below;

MMLT205 Elective 2 (i) Biomaterials
MMLT205 Elective 2 (ii) Biological System Analysis and Control
MMLT205 Elective 2 (iii) Composite Materials
MMLT205 Elective 2 (iv) Biomedical Signal and Image Processing

Biomedical Engineering and Technology (MMLT201)

Course Code	Title	Credits	NOS
MMLT201		**06**	
Unit I	Understanding of physiological system		
	Living and human instrumentation system, body temperature and coordination. Study of patient care monitoring with various physiological system. **i. Nervous System:** Neuron & its function, Sensory organs, Parts of brain, spinal cord, peripheral nerves. Electroencephalogram (EEG), **ii. Cardiovascular System:** Blood. Composition and function of blood, haemopoesis. Heart & blood vessels. Function of heart and blood vessels. Control of heart rate. Pumps/transports blood; carries to all body cells; carries waste away from cells. Electrocardiogram (ECG), Measurement of blood pressure, blood flow and cardiac output. **iii. Endocrine System:** Various endocrine glands. Secretion of glands, hormones; chemical substances regulate body activities. Detail function of each gland & clinical significance.		
Unit II	**Computer applications in biomedical Engineering**		
	Computer and monitor based biomedical instrument, Microprocessors. Biomedical computer applications. Principle of Diagnostic techniques; Ultrasonic imaging, X-ray and radio isotopic instrument, CT Scan, MRI and others.		
Unit III	**Biomechanics**		
	Scalar and Vector Quantities: Different operations on vectors, forces and moments. Stress Strain Diagram, Stress in Bending, Torsion and Compound Loading, Stress Shielding of Bone**.** Work Energy Equation, Application to Bio-Medical System. Mechanics of breathing, gas exchange and distribution, respiratory therapy equipment. Mechanical Properties of Human Bone and Soft Tissues, Cortical and Cancellous Bone, Viscoelasticity, Elastic Model of Bone.		
Unit IV	**Bioinstrumentation**		
	Development of biomedical instrumentation. Bioelectric potential. Transducers. Electrodes. Biotelemetry. Monitors and recorders. Shock hazards and prevention. Biomedical electronics. Amplifiers, Inductance, Capacitance, CRO and cathode ray tube.		

Molecular Biology & Recombinant DNA Technology (MMLT202)

Course Code	Title	Credits	NOS
MMLT202		**06**	
Unit I	**Fundamentals of Molecular Biology**		
	Continuity of life - heredity, Variation; Transmission genetics; Mendel's laws of inheritance; Mendel's gene transmission; The chromosome theory of inheritance; Patterns of inheritance- Incomplete dominance, Multiple allelism, Quantitative inheritance; Recombination; Physical evidence of recombination; Organization of prokaryotic and eukaryotic genome; Deoxyribonucleic Acid (DNA)- Structure, types, coiling and super coiling; Replication.		
Unit II	**Transcription and Translation**		
	Transcription; Prokaryotic RNA polymerase, sigma factors, initiation and termination; Eukaryotic RNA polymerases and their promoters; Processing of transcripts; Regulation of gene expression; Post transcriptional regulation; Translation and Translational control and targeting of proteins. Translation, General mechanism; Role of rRNA in translation.		
Unit III	**Gene, Genomics & Mutation**		
	Molecular structure of genes and chromosomes, Gene Regulation in eukaryotes; Gene dosage and Gene amplification. Physical and Chemical mutagens; Molecular basis; Site directed mutagenesis; Significance of Mutagenesis; DNA damage and repair; Isolating mutants; Ames test. Mutation its type; Spontaneous; Induced; Point mutation and Silent mutation; Frame-shift mutation;		
Unit IV	**Recombinant DNA Technology**		
	Introduction of rDNA into host-methods; Necessary elements – enzymes and their properties; DNA ligase; DNA modifying enzymes; Cloning vectors plasmids; Cosmids; Bacteriophages; Shuttle vectors; Expression vectors; Construction of rDNA and cloning strategies– various methods, genomic libraries (e.g. Using phage vectors), cDNA libraries; Restriction maps and Sequencing; Sanger's dideoxynucleotide, partial ribonucleotide substitution; Maxam and Gilbert's method; Pyrosequencing and single molecule sequencing.		

Molecular & Human Genetics (MMLT203)

Course Code	Title	Credits	NOS
MMLT203		**04**	
Unit I	**Basic Human Genetics**		
	Terms of Human Genetics, Chromatin structure; Chromosome organization; Mitosis; Meiosis; Chromosomal basis of inheritance, DNA as a genetic material; Methods of study of human genetics; Sex Chromatin bodies.		
Unit II	**Molecular Genetics**		
	Properties and evolution of genetic material, flow of genetic information; Genes controlling replication; pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees		
Unit III	**Cytogenetics**		
	Techniques in human chromosome analysis (including molecular techniques); Human karyotype: banding, nomenclature of banding; Fluorescent in-situ hybridization for identification of chromosomal abnormalities. Molecular repair mechanisms, Autoradiography of human chromosomes, Diseases due to defected repair mechanisms.		
Unit IV	**Clinical Genetics & Disorders**		
	Mendelian Disorders - Transmission pattern of single gene disorders, Autosomal disorders, Sex chromosome related disorders, Monogenic diseases; Inborn errors of metabolism and their genetic bases; Genome imprinting Syndromes: Genomic syndromes: Muscle genetic disorders; Genetic disorders of Haemopoitic systems; Genetic disorders of eye; Genetic disorders in skeleton and skin **;** Complex polygenic syndromes; Mitochondrial syndromes; Management of genetic disorders.		

Laboratory Management and Biostatistics (MMLT204)

Course Code	Title	Credits	NOS
MMLT204		**04**	
Unit I	**Laboratory Management I**		
	Role of laboratory in human health and diseases; Laboratory at different level (National/State/District); Duties and responsibilities of laboratory personnel; General principles of care of glassware; equipment and apparatus; Laboratory chemicals. Specimen handling & Method of collection; Method of transportation; Method of preservation and disposal of laboratory waste. Basic knowledge about the working principles, uses and care of laboratory Instruments.		
Unit II	**Laboratory Management II**		
	Ethics of the pathological clinics; Personality development and patient relationship; reports writing; Accountancy in clinical pathology; Hospital Management; General principles of safety programmes; First aid and safety measures & Universal safety precautions. Quality control and quality assurance in laboratory of (a) Biochemistry, (b) Microbiology, (c) Haematology and Blood Banking (d) Histopathology and Clinical Pathology.		
Unit III	**Biostatistics I**		
	Definition, role of statistics in health science and health care delivery system; Sample, sampling, reasons for sampling, probability and non-probability sampling, Methods of probability sampling-simple random, stratified, systematic- procedure, merits and demerits. Use of random number table. Organization of data; Frequency table, histogram, frequency polygon, frequency curve, bar diagram, pie-chart; Measures of location Arithmetic mean, median, mode, quartiles and percentiles – definition, computation (for raw data), merits, demerits and applications.		
Unit IV	**Biostatistics II**		
	Measures of variation: Range, inter –quartile range, variance, standard deviation, coefficient of variation- definition, computation (for raw data), merits, demerits and applications. Basic probability distributions. Tests of significance: Basic of testing of hypothesis – Null and alternate hypothesis, type I and type II errors, level of significance and power of the test , pvalue. Tests of significance (parametric) – t – test (paired and unpaired), Chi square test and test of proportion. Correlation and Regression:		

MMLT205 Elective 2 (i): Biomaterials

Course Code	Title	Credits	NOS
MMLT205 (i)		**06**	
Unit I	**Basics**		
	Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties.		
Unit II	**Principal**		
	Structure of cell, tissue and organ and properties of biological materials e.g., bone, teeth and connective tissue. Soft tissue and hard tissue replacement. Facial and dermal prosthesis in human body. Biocompatibility & Toxicological screening of biomaterials		
Unit III	**Instrumentation**		
	Interaction between materials and body and testing of implants. Structure property relationship of metals.		
Unit IV	**Medical implication**		
	Polymeric implant; Metallic implant; Ceramic implant; Composite implant.		

MMLT205 Elective 2 (ii): Biological System Analysis and Control

Course Code	Title	Credits	NOS
MMLT205(ii)		**06**	
Unit I	**Basics**		
	Physiological Control system: Introduction to linear control system,		
Unit II	**Principal**		
	Mathematical Modeling, Transfer function, signal flow graph, feedback control its characteristics, advantages and state-space models.		
Unit III	**Instrumentation**		
	Time-domain and frequency domain analysis. Stability analysis; Routh Hurwitz criteria, Root locus plots, Bode plots, Nyquist plots and Nichols plots. Biological performance criteria and adaptive control systems.		
Unit IV	**Medical implication**		
	Digital control, Optimal, Adaptive and Non-linear control systems. Simulation implementation. . Biological receptors, thermoregulatory system, human limb, semicircular canal, skeletal-muscle, respiratory system, pupil-control systems, neuromuscular reflex motion.		

MMLT205 Elective 2 (iii): Composite Materials

Course Code	Title	Credits	NOS
MMLT205 (iii)		06	
Unit I	**Basics**		
	Composite materials. Types of composites and their advantages.		
Unit II	**Principal**		
	Reinforcement: Glass, boron, carbon, organic and ceramic fibers, their structure, properties and processing. Micromechanic: Mechanical properties, thermal properties and load transfer. Macromechanics: Elastic behavior, fracture behavior, fatigue behavior, creep behavior of composites. Tribological and electrical behavior of composites.		
Unit III	**Instrumentation**		
	Matrix materials: Polymers, metal and ceramic matrices, their structure, properties and processing. Wettability and interface bonding. Polymer matrix composites: Lamina, laminate composites. Primary and Secondary manufacturing; Lay-up, Filament winding, pultrusion, compression moulding. Machining, drilling and routing, applications. Metal matrix composites: processing techniques and applications. Ceramic Matrix composites; processing techniques and applications.		
Unit IV	**Medical implication**		
	Biological application of composites. Degradation of composites due to various environmental conditions, corrosion resistance of composite. Designing with composites, Introduction to Nanocomposites and applications.		

MMLT205 Elective 2 (iv): Biomedical Signal and Image Processing

Course Code	Title	Credits	NOS
MMLT205 (iv)		06	
Unit I	**Basics**		
	Introduction, Characteristics of Bio - Signals, Types of Signals, Measurement, Transformation and reduction, computation of signal parameters that are diagnostically significant, stationary and non - stationary bio - signals, Z transform introduction, definition, convergence. Inverse Z transforms, Analysis of discrete time systems using Z transforms. Solutions of differential equations. Transfer functions and stability. Fundamentals of digital image processing. Storage and display operation properties of digital image. Image preprocessing by statistical and probabilistic methods.Image enhancement and restoration. Segmentation of images by applying Thresh hold, Edge based and Region based techniques. Image feature extraction, analysis of medical images.		
Unit II	**Principal**		
	Fourier transform for continuous signals. Energy spectrum, Properties (without proof), Gibbs phenomena, Auto and cross correlation. Discrete Fourier transforms. Properties (without proof), Inverse DFT, introduction to FFT		
Unit III	**Instrumentation**		
	IIR & FIR Filters, Low pass, High Pass, Band Pass Filters using windows – Kaiser Windows. Sampling Theorem, aliasing Nyquist criteria, ADC's and DAC's.		
Unit IV	**Medical implication**		
	Use of Matlab signal processing toolbox on various real bio - medical signals. Application areas of Bio -Signals analysis - EEG, ECG, Phonocardiogram, Spiro Gram, Evoked Signals. Medical imaging systems; X-ray system, C.T. Scan, Ultrasound (A, B and M scans). MRI and Positron Emission Tomography.		

MMLTP206: Practical's of Biomedical Engineering and Technology

MMLTP206	Practical's of Course Biomedical Engineering and Technology	02	NOS
1.	To operate B. P apparatus.		
2.	ECG machine procedure and performance.		
3.	Application of ventilator.		
4.	Boyle' Apparatus and its application		
5.	Use of pulse oxymeter		
6.	Engineering of glucometer		
7.	Study of audiometer and visual testing instruments.		
8.	Measurement of leakage current with the help of safety analyzer		
9.	To Study the Heart Model and simulate it using MATLAB/SIMULINK		
10.	To Study the Eye Movement System, its mathematical mode.		
11.	To study model of respiratory mechanics		
12.	Body temperature measurement.		
13.	BMI index evaluation.		
14.	Uses of Incubator in NICU.		
15.	Instrumentation of ultrasound machine.		

MMLTP207: Practical's of Molecular Biology & Recombinant DNA Technology

MMLTP207	Practical's of Course Molecular Biology & Recombinant DNA Technology	02	NOS
1.	Isolation of DNA from bacterial cells/human sample (blood/tissue).		
2.	Isolation of RNA from bacterial cells/human sample (blood/tissue).		
3.	Isolation of proteins from various human sample.		
4.	Estimation and quantitation of DNA.		
5.	Estimation and quantitation of RNA.		
6.	Estimation and quantitation of protein.		
7.	Isolation of plasmids from bacterial cells.		
8.	DNA visualization using ultraviolet rays.		
9.	Horizontal/Vertical Agarose Gel electrophoresis.		
10.	SDS PAGE for native protein		
11.	Amplification of DNA fragments using PCR		
12.	Sequencing techniques		
13.	Karyotyping and banding pattern.		
14.	Isolation and preparation of phages.		
15.	Transformation and cloning.		

Masters of Vocation (Medical Laboratory Technology)

M. Voc. (MLT)

Second Year

Semester III

Course Code	Component	Unit	Topic	Credits	L /Week
MMLT301 (Histopathology and Cytopathology)	**Skill**	**I**	Histopathology I	06	01
	Skill	**II**	Histopathology II		01
	Skill	**III**	Cytopathology I		01
	Skill	**IV**	Cytopathology I		01
MMLT302 (Medical Parasitology)	**Skill**	**I**	General Parasitology	06	01
	Skill	**II**	Diagnostic Parasitology		01
	Skill	**III**	Mycology		01
	Skill	**IV**	Diagnostic Mycology		01
MMLT303 Elective 3	**Skill**	**I**	Basics	04	02
	Skill	**II**	Principal		01
	Skill	**III**	Instrumentation		02
	Skill	**IV**	Medical implication		01
MMLT304 Dissertation / Project	**Skill**	**I**	Sample collection & Segregation	10	03
	Skill	**II**	Biomedical Coding		02
	Skill	**III**	Instrument handling		03
	Skill	**IV**	Report drafting and submission		02
MMLT305 (Seminar)	**General**	**I**	Problem Search	04	02
	General	**II**	Hypothesis generation		01
	General	**III**	Work plan		02
	General	**IV**	Presentation &Teaching ability		01
Total Credits				**30**	

Elective 3: Student opt any one in given below;

MMLT303: Elective 3 (i) : Research Methodology in Health Sector
MMLT303: **Elective 3** (ii) **:** Effects of Radiation and Biomedical Applications of Radiation
MMLT303: **Elective 3** (iii) **:** Bio ceramics

Histopathology and Cytopathology (MMLT301)

Course Code	Title	Credits	NOS
MMLT301		**06**	
Unit I	**Histopathology I**		
	Introduction & importance of histopathology - Branches of Histopathology, Organisation of Histology Laboratory; Histology equipment, Specimen Reception; Method of specimen collection - Types of Biopsy Procedures, Examination of Tissues and Cells; Automation in Histopathology. **Stains and Staining**: Dyes and their properties - Theory of staining; Types of staining - H and E Staining, Mounting of Sections, Periodic Acid Schiff (PAS), Feulgen Stain, Masson's Trichrome, Giemsa Stain, Phosphotungstic Acid-haematoxylin Stain, The Papanicolaou Stain; Main characteristics and modification - Factors Influencing Staining Reaction, Stains for Sex Chromatin, Stains for Pigments, Stains for microorganism, Stain for parasites, Stain for carbohydrate, Stain for lipids, Stain for Nucleic Acid. **Tissue Typing & Transplants**: Kidney transplant - Tissue typing & techniques Tissue typing; Lymphocyte Reaction -, Minor Histocompatibility antigen.		
Unit II	**Histopathology II**		
	Tissues Fixative: Fixative, its types and their properties; Histo-chemical fixatives. **Tissue Processing**: Decalcification - Determining the End-point of Decalcification, Neutralization and Processing; Embedding - Microtome, Microtome Knives, Technique of Section Cutting and Mounting on Slide; Frozen Section - Cryostat. **Molecular Histopathology**: Methods in molecular pathology, Tissue micro dissection methods; Amplification method, PCR, Gel electrophoresis methods, Hybridization methods, Nucleic acid sequencing, DNA microarrays, Proteomics; Molecular pathological diagnostics - Molecular genetic testing, Testing Methodology; Molecular oncological testing - Molecular markers of malignant neoplasms, Molecular techniques, Automated Cellular Imaging System.		
Unit III	**Cytopathology I**		
	Cytology and Cytopathology - Fixation, Fixative, Common fixative, Special purpose fixative; Fluid specimen - Preservation before processing, Preparation for microscopy.		
Unit IV	**Cytopathology II**		
	Cervical Cytology: Overview of Cervical Cytology - Method of Conducting Pap Test, Collection and Transportation, Special Instructions for Requisition, Causes for Rejection of Specimen or Limited Reports; Results of Pap Test - Aspects of Pap Test, Effectiveness of Pap Test, Practical Aspects of Pap Test; Bethesda System - Types of Results, Squamous Cell Abnormalities, Bethesda System 2001 for Cervicovaginal Cytology Reporting, Carcinoma - Hormonal assessment, Cytological techniques, Special collection method, Clinical applications. **Recent Advances in Cytopathology**: Fine Needle Aspiration Cytology (FNAC); Thin Layer Cytology & Immunofluorescent Techniques - Thin Layer Cytology, Immunofluorescent Techniques, Flow cytometry; Advances in Lung Cytopathology - Advances in Cytopathology for Lung Cancer, Advances in Urinary Cytopathology, Advances in Cytopathological Evaluation of Lymphomas; New Techniques for Obtaining Samples for Cytopathological Examination - Automation in Cytology. **Cancer Immunology**: Immune response to cancer - Evasion of immune system by tumour cells; Malignant transformation of cells - Oncogenes and Tumor Suppressor Genes, Effect of Tumors on Host, Host Response against Tumor; Tumor Specific Antigen - Immune Responses, Prospects of Immunotherapy.		

Medical Parasitology (MMLT302)

Course Code	Title	Credits	NOS
MMLT302		**06**	
Unit I	**General Parasitology:**		
	Classification of medical parasitology; Pathogenesis of parasitic diseases; Host parasite relationship, Opportunistic Parasitic Infections. Morphology & structure and classification of viruses, Principles of viral diseases, Pathogenesis of viral diseases, Prevention and treatment of viral infections - Basic mechanisms, Activity spectrum of major antiviral compounds. Bacteriophage. Systematic study of parasites; General Characteristics of Medically Important Parasites; Protozoa, Plasmodia - Plasmodium Falciparum, Plasmodium Vivax, Plasmodium Malariae, Plasmodium Ovale; Leishmania - Hemoflagellates, Trypanosoma, American Trypanosomiasis, Toxoplasma, Babesia; Helminthes - Helminth Parasites; Nematodes (Round Worms) - Hook Worms, Strongyloides Stercoralis; Intestinal Nematodes without Tissue Stage - Enterobius Vermicularis (Pin Worm or Thread Worm), Trichuris Trichiura (Whip Worm); Tissue Nematodes - Filarial Worms, Loa Loa; Biological Vectors, Arthropods.		
Unit II	**Diagnostic Parasitology**		
	Diagnostic Parasitology: Examination of Stool for Parasitology - Parasite Concentration in Faeces by Floatation, Examination of Blood for Parasites, Serological Tests for Parasites; Examination of Biopsy Material and Body Fluid; Drugs for protozoal infections - Pharmacotherapy of Malaria, Antibiotics.		
Unit III	**Mycology**		
	Mycology: Introduction to Fungi, General characteristics; Taxonomy of Fungi- Binomial nomenclature Classifications of Fungi; Immunity to Fungal Diseases - Innate and Adaptive immunity to Fungi; Laboratory diagnosis fungal diseases - Fungal Tests; Definition of Mycoses and types - Classification of Mycoses; Role of Mycotoxin - Definitions, Etymology and General Principles, Prevention by Antifungal Agents; Culture Media in Mycology - Constituents of Media, Stains in Mycology. Superficial and Subcutaneous Mycoses: ex. Dermatitis; Systemic Mycoses: ex. Histoplasmosis, Blastomycosis, Opportunistic Mycoses: Candidiasis,Cryptococcosis, Pneumocystosis; Aspergillosis, Miscellaneous Mycoses Oculomycosis, Otomycosis.		
Unit IV	**Diagnostic Mycology**		
	Specimen collection - Laboratory Methods in Medical Mycology, Direct Examination of Specimens, Fungal Culturing; Biochemical Studies; Identification of some common fungus - Saprophytes; Anti-Fungal Agents; Serological Tests for Mycotic Infections; Use of Laboratory Animals in Mycology - Typing of Fungi; Preparation of Fungal Antigens and their Standardization, Disk Diffusion.		

Elective 3(MMLT303) (i): Research Methodology in Health sector

Course Code	Title	Credits	NOS
MMLT303 (i)		04	
Unit I	**Basic**		
	Topic selection, Introduction, Aim: The aim of this Module is to provide the student with experience of research methods and techniques while working alongside research laboratory staff on a designated research project.		
Unit II	**Principal**		
	Objective: (i) design, carry out, write up and critically appraise a selected research topic; (ii) demonstrate knowledge of skills in appropriate research laboratory practices; (iii) carry out a range of laboratory techniques using appropriate methodologies. **Review of literature** Constituency: These modules are intended for students who wish to learn research methods and techniques and perhaps do a research in the future. Some experience of laboratory practice would help the student to take full advantage of this module, although in most instances students will be fully trained in all necessary techniques. 1. Review of literature Planning the review: the role of the literature review and specification of the task 2. Identification of relevant literature both published and unpublished: developing a search strategy and using bibliographic databases. 3. Appraising the literature: methods for assessing the quality of quantitative and qualitative research.		
Unit III	**Instrumentation**		
	Lay out & Conceptual outline: Each student will choose an individual research project and will be directly supervised by an expert in the field **Material s and methods:** This is a purely practical module designed to introduce students to a variety of research techniques and to give them the opportunity of using these techniques in conducting a novel a research project. **Teaching strategy:** This Module will necessitate long working hours in some cases and may involve some students studying at institutions other than the parent Institution. Teaching is on a one-to-one basis with a designated supervisor. Students must be highly motivated and be prepared to work long hours in order to make a success of this module.		
Unit IV	**Medical implication**		
	Results, Observation , Discussion, Summary, Conclusion and implication, References		

Elective 3 (MMLT303) (ii): Effects of Radiation and Biomedical Applications of Radiation

Course Code	Title	Credits	NOS
MMLT303 (ii)		04	
Unit I	**Basic**		
	Basic concepts, types, sources and characteristics of electromagnetic radiations and its influence on living beings with particular emphasis on human beings.		
Unit II	**Principal**		
	Biological effects and Biomedical applications of X- Rays, Gamma–rays, Microwaves, Ultrasound etc.		
Unit III	**Instrumentation**		
	Lasers: classification, basic concept, types. Scintillation counter, Gamma counter, Radioisotopes and radiation detector.		
Unit IV	**Medical implication**		
	Biomedical Applications of radiation. Laser use in surgery, diagnosis and in promotion of healing.		

Elective 3 (MMLT303) (iii): Bio ceramics

Course Code	Title	Credits	NOS
MMLT303 (iii)		04	
Unit I	**Basic**		
	Definition and scope of bio-materials. Structure, properties and functional behavior of bio-materials. Classification of bio-ceramic materials for medical applications.		
Unit II	**Principal**		
	Structure-property relationship of biological materials, structure of proteins, polysaccharides, structure-property relationship of hard tissues cell, bone, teeth and connective tissues.		
Unit III	**Instrumentation**		
	A.W. machinable and phosphate glass ceramics. Dense and porous hydroxyl apatite calcium phosphate ceramics, coatings and resorbable ceramics. Carbon as an implant. CMC and PMC composites.		
Unit IV	**Medical implication**		
	Tissues response to implants (bio-compatability, wound healing process), body response to implants, blood compatability. Alumina and zirconia in surgical implants, bioactive glasses and their clinical applications, Regulation of medical devices.		

Dissertation / Project (MMLT304)

Course Code	Title	Credits	NOS
MMLT304		10	
Unit I	Problem Search, Hypothesis generation , Sample collection & Segregation		
Unit II	Biomedical Coding Full term for 1 year Dissertation / Project Topic Allotment and commencement of work		
Unit III	Instrument handling		
Unit IV	Report drafting and submission		

Seminar (MMLT305)

Course Code	Title	Credits	NOS
MMLT305			
Unit I	Problem Search: Dissertation / Project Topic put for seminar, Introduction	04	
Unit II	Hypothesis generation: Aim and objective		
Unit III	Work plan and Material and methods, Results, observation, discussion		
Unit IV	Seminar Presentation &Teaching ability		

Masters of Vocation (Medical Laboratory Technology)

M. Voc. (MLT)

Second Year

Semester IV

Course Code	Component	Unit	Topic	Credits	L /Week
MMLT401 (Noninvasive techniques)	**Skill**	**I**	Noninvasive techniques I	06	02
	Skill	**II**	Noninvasive techniques II		01
	Skill	**III**	Noninvasive techniques III		02
	Skill	**IV**	Noninvasive techniques IV		01
MMLT402 (Bioinformatics and Medical Transcription)	**Skill**	**I**	Bioinformatics I	06	02
	Skill	**II**	Bioinformatics II		01
	Skill	**III**	Medical Transcription I		02
	Skill	**IV**	Medical Transcription II		01
MMLT403 (Elective 4: Specialization)	**Skill**	**I**	Basics	06	02
	Skill	**II**	Principal		01
	Skill	**III**	Instrumentation		02
	Skill	**IV**	Medical implication		01
MMLT404 (Dissertation / Project)	**Skill**	**I**	Skill performance	10	03
	Skill	**II**	Quality control		02
	Skill	**III**	Thesis Submission		03
	Skill	**IV**	Viva		02
MML405 (Seminar)	**General**	**I**	Problem Search	06	02
	General	**II**	Hypothesis generation		01
	General	**III**	Work plan		02
	General	**IV**	Presentation &Teaching ability		01
Total Credits				30	

MMLT403 Elective 4: Student opt any one specialization in given below;

I. Medical Histology (Job Role: Duty Manager Histology)
II. Medical Cytology (Job Role: Duty Manager Cytology)
III. Blood Bank (Job Role: Blood Bank Duty Manager)
IV. Medical Genetics (Genetic Counseling) (Job Role: Genetic Counselor)
V. Molecular Diagnosis (Job Role: Duty Manager – Molecular Diagnosis)
VI. Immunodiagnostics (Duty Manager – Immunodiagnosis)

Job Role: Duty Manager – Patient Relation Services (NSQF Level 7)

Noninvasive Techniques (MMLT401)

Course Code	Title	Credits	NOS
MMLT401		**06**	
Unit I	**Noninvasive techniques** I		
	Role of Noninvasive lab in Health Care, Fundamental Principles of Stress test and its importance Imaging Techniques: X-Ray - Fundamentals of X-ray, Generation and Detection of X-rays, X-ray Diagnostic Methods. Computerized Tomography: Basic principles, diagnostic methods, Positron Emission Tomography (PET).		
Unit II	**Noninvasive techniques** II		
	Nuclear medical imaging: Fundamentals of Radioactivity, Diagnostic Methods, EEG-Recording, ECG, EMG, Single Photon Emission Computed Tomography (SPECT),		
Unit III	**Noninvasive techniques** III		
	Fundamental Principles of Holter monitoring and machine details. Magnetic Resonance Imaging: Fundamentals of Nuclear Magnetic Resonance, Imaging Methods, Ultrasound -Fundamentals of Acoustic Propagation, Ultrasonic Diagnostic Methods.		
Unit IV	**Noninvasive techniques** III		
	Ophthalmological examination: Visual acuity test, Fluorescein angiography; Opthalmascopy, OculoplethysmographyTranscranial Doppler studies, Evoked potential studies. Mammography: Mammographic unit, breast dose, low-dose mammography. Electrocardiography, Electroencephalography.		

Bioinformatics and Medical Transcription (MMLT402)

Course Code	Title	Credits	NOS
MMLT402		**06**	
Unit I	**Bioinformatics I**		
	Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, Fasta, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles: Basic concept and definition of sequence patterns, motifs, domains and profiles; various types of pattern representations viz. consensus, regular expression (prosite-type) and profiles. Sequence Alignment: Pairwise sequence alignments: Dot matrix for sequence alignment, Dynamic programming for Local and Global alignment; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup.		
Unit II	**Bioinformatics II**		
	Scoring Matrics: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived; Sequence-based database searches: Need of sequence based database search, BLAST and FASTA algorithms, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST. Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis. Protein structure prediction: Secondary structure prediction (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and Tertiary structures prediction (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.), Application of bioinformatics in drug discovery and drug designing.		
Unit III	**Medical Transcription I**		
	Introduction and Medical Terminology: IT enabled serv ices, Need of medical transcription, Equipments used. Medical terminology-Word root, combining form, Suffixes- prefixes, Formation and defining medical words. **Organ systems:** Orthopedics, Neurology, Ophthalmology, Endocrinolo gy, Otorhinolaryngology, Pulmonolgy, Dermatology, Gastroenterology, Cardiology, Urology, Gynecology and obstetrics (Anatomy and physiology, Pathology, Lab procedures, Drug used Vocabulary, Abbreviation)		
Unit IV	**Medical Transcription** II		
	Blood system: Im mune system , Lym phatic system , Hem atology. Psychiatry- Representativ e diseases, Diagnostic procedures, treatm ents. Pharmacology. **Marketing of medical transcription :**Market research and analysis, Target marketing. Editing and phonetic problem solving-Types of errors, Editing, Proofreading. **Tools for medical transcription**: Transcription Guidelines, Formatting of reports, English Grammar- Parts of Speech, Subject v erb agreement, Tense, Punctuation.		

Elective 4(MMLT403): Specialization I to VI

I. Medical Histology (Job Role: Duty Manager Histology)

Course Code	Title	Credits	NOS
MMLT 403 (I)		**06**	
Unit I	Basic		
	Model Curriculum : HEALTHCARE ALLIED HEALTH		
Unit II	Principal		
	Job Role: Medical Lab Technician		
Unit III	Instrumentation		
Unit IV	Medical implication		
	NSQF LEVEL: 4		

II. Medical Cytology (Job Role: Duty Manager Cytology)

Course Code	Title	Credits	NOS
MMLT 403 (II)		**06**	
Unit I	Basic		
	Model Curriculum: HEALTHCARE ALLIED HEALTH		
Unit II	Principal		
	Job Role: Patient Relations Associate		
Unit III	Instrumentation		
Unit IV	Medical implication		
	NSQF Level 5		

III. Blood Bank (Job Role: Blood Bank Duty Manager)

Course Code	Title	Credits	NOS
MMLT 403 (III)		**06**	
Unit I	Basic		
	Model Curriculum: HEALTHCARE ALLIED HEALTH		
Unit II	Principal		
	Job Role Assistant Duty Manager – Patient Relation Services		
Unit III	Instrumentation		
Unit IV	Medical implication		
	NSQF Level 6		

IV. Medical Genetics (Genetic Counseling) (Job Role: Genetic Counselor)

Course Code	Title	Credits	NOS
MMLT 403 (IV)		**06**	
Unit I	Basic		
	Model Curriculum		
Unit II	Principal		
	Job Role: Patient Relations Associate		
Unit III	Instrumentation		
Unit IV	Medical implication		
	NSQF Level 5		

V. Molecular Diagnosis (Job Role: Duty Manager – Molecular Diagnosis)

Course Code	Title	Credits	NOS
MMLT403 (V)		**06**	
Unit I	Basic		
	Model Curriculum: HEALTHCARE ALLIED HEALTH		
Unit II	Principal		
	Job Role: Duty Manager – Patient Relation Services		
Unit III	Instrumentation		
Unit IV	Medical implication		
	NSQF Level 7		

VI. Immunodiagnostics (Duty Manager – Immunodiagnosis)

Course Code	Title	Credits	NOS
MMLT 403 (VI)		**06**	
Unit I	Basic		
	Model Curriculum: HEALTHCARE ALLIED HEALTH		
Unit II	Principal		
	Job Role: Duty Manager – Patient Relation Services		
Unit III	Instrumentation		
Unit IV	Medical implication ;		
	NSQF Level 7		

Dissertation / Project (MMLT404)

Course Code	Title	Credits	NOS
MMLT404		10	
Unit I	Thesis Submission		
Unit II	Skill performance		
Unit III	Quality control / Assurance		
Unit IV	Viva		

Seminar (MMLT405)

Course Code	Title	Credits	NOS
MMLT405			
Unit I	Problem Search from Dissertation / Project Topic put for seminar, Introduction	06	
Unit II	Hypothesis generation: Aim and objective		
Unit III	Work plan and Material and methods, Results, observation, discussion		
Unit IV	Seminar Presentation &Teaching ability		