SCHEME & SYLLABUS
B.Sc. Medical Laboratory Sciences

Department of Life Sciences & Allied Health Sciences

University Institute of Science and Humanities

Sant Baba Bhag Singh University
2019

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Course Scheme

Scheme for B.Sc. MLS

SEMESTER I

I. Theory Subjects

Sr. No.	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	MLS 101	Basics of Medical Lab Technology	4:0:0	4:0:0	4	4
2	MLS 105	Fundamentals of Biology	4:0:0	4:0:0	4	4
3	MLS 109	General Microbiology	4:0:0	4:0:0	4	4
4	MLS 113	Hematology – I	4:0:0	4:0:0	4	4
5	ENG 101	General English – I	3:0:0	3:0:0	3	3

II. Practical Subjects

1	MLS 103	Basics of Medical lab Technology Practical	0:0:3	0:0:1.5	3	1.5
2	MLS 107	Fundamentals of Biology Practical	0:0:3	0:0:1.5	3	1.5
3	MLS 111	General Microbiology Practical	0:0:3	0:0:1.5	3	1.5
4	MLS 115	Haematology – I Practical	0:0:3	0:0:1.5	3	1.5

Total Contact Hours: 31
Total Credit Hours: 25

Semester II

I.Theory Subjects

Sr. No	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	MLS 102	Biochemistry – I	4:0:0	4:0:0	4	4
2	MLS 106	Human anatomy & Physiology – I	4:0:0	4:0:0	4	4
3	MLS 110	Pathology-I (Medical Parasitology)	4:0:0	4:0:0	4	4
4	MLS114	Hematology –II	4:0:0	4:0:0	4	4
5	ENG 102	General English-II	3:0:0	3:0:0	3	3

II. Practical Subjects

1	MLS 104	Biochemistry -I Practical	0:0:3	0:0:1.5	3	1.5
2	MLS 108	Human anatomy & Physiology – I Practical	0:0:3	0:0:1.5	3	1.5
3	MLS 112	Pathology - I Practical	0:0:3	0:0:1.5	3	1.5
4	MLS 116	Hematology-II Practical	0:0:3	0:0:1.5	3	1.5
	PT 102/104/106	Physical Training (NSO/NSS/NCC)	0:0:2	Non Credits	2	NC

Total Contact hrs: 33
Total Credit Hours: 25

Semester-III

I. Theory Subjects

Sr. No.	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	MLS 201	Biochemistry –II	4:0:0	4:0:0	4	4
2	MLS 205	Human anatomy & Physiology – II	4:0:0	4:0:0	4	4
3	MLS 209	Pathology –II (Systematic Bacteriology)	4:0:0	4:0:0	4	4
4	MLS 213	Basics of Biochemical & biophysical techniques	4:0:0	4:0:0	4	4
5	EVS 101	Environmental Science	3:0:0	3:0:0	3	3

II. Practical Subjects

1	MLS 203	Biochemistry II Practical	0:0:3	0:0:1.5	3	1.5
2	MLS 207	Human anatomy & Physiology – II Practical	0:0:3	0:0:1.5	3	1.5
3	MLS 211	Pathology -II Practical	0:0:3	0:0:1.5	3	1.5
4	MLS 215	Basics of Biochemical & biophysical techniques Practical	0:0:3	0:0:1.5	3	1.5
5	CSE 213	Basics of Computers Practical	0:0:3	0:0:1.5	3	1.5

Total Contact hrs: 34
Total Credit Hours: 26.5

Semester-IV

I. Theory Subjects

Sr. No.	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	MLS 202	Clinical Biochemistry-I	3:0:0	3:0:0	3	3
2	MLS206	Hematology - III	3:0:0	3:0:0	3	3
3	MLS210	Pathology-III (Mycology)	2:0:0	2:0:0	2	2
4	MLS214	Concepts in immunology and immunological techniques	4:0:0	4:0:0	4	4
5	MLS218	Histopathology & Histopathological Techniques	4:0:0	4:0:0	4	4
6	MLS222	Basics of Virology	2:0:0	2:0:0	2	2

II. Practical Subjects

1	MLS204	Clinical Biochemistry-I Practical	0:0:3	0:0:1.5	3	1.5
2	MLS208	Hematology - III Practical	0:0:3	0:0:1.5	3	1.5
3	MLS212	Pathology-III Practical	0:0:3	0:0:1.5	3	1.5
4	MLS216	Concepts in Immunology and Immunological Techniques Practical	0:0:3	0:0:1.5	3	1.5
5	MLS220	Histopathology & Histopathological Techniques Practical	0:0:3	0:0:1.5	3	1.5
	PT 102/104/106	Physical Training (NSO/NSS/NCC)	0:0:2	Non Credits	2	NC

Total Contact hrs: 35
Total Credit Hours: 25.5

Semester-V

I. Theory Subjects

Sr. No.	Subject Code	Subject Name	L:T:P	Credit hours	Total Contact Hours	Total Credits
1	MLS 301	Clinical Biochemistry –II	3:0:0	3:0:0	3	3
2	MLS 305	Pathology –IV (Cellular and Histopathology)	4:0:0	4:0:0	4	4
3	MLS 309	Blood Banking and Transfusion Reactions	3:0:0	3:0:0	3	3
4	MLS 313	Health Systems and Laboratory Ethics	4:0:0	4:0:0	4	4
5	MLS 317	Histotechnology and Cytology	4:0:0	4:0:0	4	4
6	COM317	Generic skills and Entrepreneurship	2:0:0	2:0:0	2	2

II. Practical Subjects

1	MLS 303	Clinical Biochemistry - II Practical	0:0:3	0:0:1.5	3	1.5
2	MLS 307	Pathology -IV Practical	0:0:2	0:0:1.0	2	1.0
3	MLS 311	Blood Banking and Transfusion Reactions Practical	0:0:2	0:0:1.0	2	1.0
4	MLS 315	Health Systems and Laboratory Ethics Lab	0:0:2	0:0:1.0	2	1.0
5	MLS 319	Histotechnology and Cytology Practical	0:0:3	0:0:1.5	3	1.5
6	PT 101/103/105	Physical Training (NSO/NSS/NCC)	0:0:2	Non Credits	2	NC

Total Contact hrs: 34
Total Credit Hours: 26

Semester – VI

I. Theory Subjects/Training

Sr. No.	Subject Code	Subject Name	L:T:P	Credit hours	Total Contact Hours	Total Credits
1	MLS 302	Professional Training			3 Months	25
						25

Total Credit: 25

Course Scheme Summary

Sem	L	T	P	Contact hrs/wk	Credits	Project (prj)/ Training (trg)
1	19	0	12	31	25	NC
2	19	0	14	33	25	NC
3	19	0	15	34	26.5	NC
4	18	0	17	35	25.5	NC
5	20	0	14	34	26	NC
6	0	0	0	0	25	3 months

Total Contact hrs for I-VI semester: 167
Total Credit Hours for I-VI semester: 153

First Semester

Basics of Medical Lab Technology

Course Code	**MLS101**
Course Title	Basics of Medical Lab Technology
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	• To understand the role of healthcare professional. • To impart basic knowledge of laboratory principles, procedures and techniques.

UNIT-I

General overview: classification and organization of medical laboratories, Role of medical laboratory services, lab technologists, lab rules, professional ethics and professional code of conduct.

Laboratory Safety: General principles, laboratory hazards and factors contributing to laboratory hazards, universal safety measures and First aid in the laboratory.

Laboratory ware: Types, use and calibration of following; pipettes, burettes, flasks, beakers, cylinders, test tubes, petri dishes etc. plasticware: PVC, polycarbonate, Teflon; composition, properties, varieties, grades of glass wares. Advantages and disadvantages of various disposable lab ware.

Cleaning of laboratory wares: Preparation of cleaning solutions, general and specific cleaning procedures, care of laboratory wares and utensils, grades of chemicals, storage and handling of chemicals and reagents.

UNIT-II

Equipments: Introduction to common equipments used in laboratory: Principles, operation, use, care and maintenance of Electronic weighing balance, pH meter, centrifuge, hot air oven, water bath and colorimeter.

UNIT-III

Solution preparation: UNITs of weight and volume, methods of expressing concentration of solution: Molarity, Normality, Molality, percent solution, saturated solutions and standard solutions.

Buffers: Buffer solutions and their storage, preparation of commonly used laboratory buffers.

Distillation: preparation and use of distilled water, storage and type of distillation units.

UNIT-IV

Concept of pH: dissociation of water, ionic product, pH concept, Henderson Hasselbalch equation, pH measurements, Buffer solutions and buffering capacity

Electrolyte Balance: types of body fluids, distribution of body water and electrolytes, normal water balance, normal electrolyte balance, regulatory mechanism, pathological variations of water and electrolytes and water intoxication.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	P. B. Godker and Darshan P. Godkar	Bhalani Publisher
2.	Medical Laboratory Technology, Volume 3	KL Mukherjee & S.Ghosh	Tata McGraw Hill
3.	Practical Clinical Biochemistry	Harold Varley	CBS Publishers & Distributers
4.	Text book of Medical Biochemistry	M.N. Chaterjee and R. Shinde	Jaypee Brothers Medical Publishers(P) Ltd.
5.	Principles of Biochemistry	A.Lehninger	WH Freeman Publisher & Co.
6.	Biochemistry	Lubert Stryer.	WH Freeman Publisher

Fundamentals of Biology

Course Code	**MLS105**
Course Title	Fundamentals of Biology
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	To impart introductory knowledge about • Biology of the cell- the basic building UNITs of an organism, • Human physiology- a glimpse at the orchestrated functioning of organ systems and • Basic principles of genetics as seen in nature and diversity in life forms to the students.

UNIT-I

Introductory Biology: Definition of life, characteristics of life, differences between animals and plants, principal divisions in biology and importance of biology.

Physiology: Introduction to various systems in human body-Digestive system, respiratory system, circulatory system, endocrine system, reproductive system.

UNIT-II

Cell Biology: Definition of cell, Cell as a basic UNIT of living systems, fundamental cell types (PPLO's, bacteria, eukaryotic microbes, plant and animal cells), difference between prokaryotic and eukaryotic cells, Structure and function of cell organelles, ultrastructure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.), Mitochondria, lysosomes, nucleus.

Tissue: definition, classification, microscopic structure & function of epithelial, muscular, connective & nervous tissue.

Cell Cycle: Cell division; mitosis, meiosis, stages of cell cycle, Cell Senescence and Death (Apoptosis and necrosis), Cell Differentiation in Animals: Totipotent, multipotent, pleuripotent cells.

UNIT-III

Basics of genetics: Mendel's work and experiments, gene: bearer of heredity character, chemical basis of heredity. Chromosome structure, structural aberrations and human karyotype.

Evolution: Origin of life, theories of evolution, evidences of evolution from plant and animal kingdom, modern concept in Evolution and concept of speciation.

UNIT-IV

Biodiversity: Variety of living organisms, Systematic, need, history and types of classifications (artificial, natural, phylogenetic), biosystematics; binomial nomenclature; Two kingdom system, Five kingdom system, their merits and demerits.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Cell Biology, Genetics, Molecular Biology, Evolution & Ecology	PS Verma & VK Aggarwal	S.Chand
2	Fundamentals of genetics	Peter J Russell	
3	Fundamentals of genetics	G.S Miglani	
4.	Cytogenetics, Molecular Biology and Evolution	KN Bhatia	Trueman Publishers
5.	Cell Biology and Genetics	KN Bhatia and Neelam Dhand	

General Microbiology

Course Code	MLS109
Course Title	General Microbiology
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	To introduce basic principles and core concepts of microbiology, including the evolution and diversity of microbes; cell structure and function; metabolism; information flow and the role of microbes.

UNIT-I

Introduction: Nomenclature & Classification of micro-organisms, Historical review (Contributions of E. Jenner, L. Pasteur, Robert Koch and postulates, Anton van Leeuwenhoek, Alexander Fleming) and scope of microbiology**,** Role of medical microbiology in diagnosis and control of infections.

UNIT-II

Safety measures in Medical Microbiology: Introduction- Care and handling of glassware, cleaning of glassware

Equipments used in clinical Microbiology Laboratory: Introduction - Care and maintenance, Autoclaves: types, principle, operational procedure, precautions and applications Incubators: types, design, principle, operational procedure, precautions and applications, Laminar air flow: principle, operational procedure, precautions and applications Quebec colony counter: principle, operational procedure, precautions and applications

UNIT-III

Principle and uses of various microscopes: Compound, Light, Darkfield, Brightfield, phase-contrast, Fluorescent and Electron- SEM & TEM

Sterilization and disinfection methods: Classification of sterilization and Disinfection, Different methods of sterilization: Heat, radiation, filtration, chemical methods, antisepsis and asepsis. Pasteurization and serum inspirator

Staining methods: Types of stains; acidophilic, basophilic and neutral Staining procedures: principle, procedures, uses, advantages and disadvantages of simple staining, Gram staining, negative staining**,** fluorochrome staining, stains for spirochetes and spores.

UNIT-III

Morphology of bacteria: structure and function of bacterial cell, anatomy of bacterial cell including collection, transport and processing of specimens.

Growth and nutrition: Culture media and culture methods-aerobic and anaerobic, Metabolism of bacteria, growth curve of bacteria, use of culture media in diagnostic bacteriology, Bacterial toxins, Anti- microbial agents, Antimicrobial susceptibility tests, Quality control and safety.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Practical Medical Microbiology Volume 1 and Volume 2	Mackie & MacCartney	Churchill Living Stone
2	Text book of Microbiology	Ananthanereyan and Paniker	Universities Press
3	Medical Microbiology	Paniker &Satish Gupte	Universities Press
4	Text book of Microbiology	Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg	Tata McGraw Hill
5.	Text book of Microbiology	D.R Arora & B. Arora	CBS Publishers

Hematology-I

Course Code	MLS113
Course Title	Hematology-I
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	To study the components, characteristics and functions of human blood and to identify principles and procedures of routine hematological tests including sources of error and clinical significance of results.

UNIT-I

Introduction to hematology: Importance, laboratory organization and equipment used, safety measurements in hematology laboratory.

UNIT-II

Hematopoiesis: Erythropoiesis, leucopoiesis, thrombopoiesis, Stem cells, formed elements and their functions, Anticoagulants used in various haematological studies.

UNIT-III

Staining techniques in hematology: Principle, procedure and preparation of following stains:

- Giemsa stain
- Leishman stain
- Wright`s stain
- Field`s stain

UNIT-IV

Routine hematological tests: Principle, procedures, normal values and clinical significance:

- Determination of Haemoglobin by Sahli`s method and Cyanmethhemoglobin method
- Determination of Haematocrit
- Enumeration of RBC, WBC & Platelets
- Absolute Eosinophil count
- Reticulocyte count
- Calculation of Red cell Indices
- Preparation of blood film
- Staining of blood film for morphology of red cells and
- Differential count

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Hematology for students Practitioners	Ramnik Sood	Jaypee Brothers Medical Publishers

2	Hematology (International edition)	Emmanuel C. Besa	Harwal Publisher
3	Practical Hematology (8th edition)	Sir John V Dacie & S Mitchell Lewis	Churchill Living Stone
4.	Clinical Hematology	Christopher A. Ludlam	Churchill Living Stone
5.	Atlas of hematology (5th edition)	G.A. McDonald, James Paul & Bruce cruickshanl	Churchill Living Stone
6.	A Manual of Laboratory & Diagnostic Tests (6th edition)	Frances Fischbach	Lippin Cott wiliam & wilkins

General English-I

Course Code	**ENG101**
Course Title	General English-I
Type Course	Theory
L T P	3 0 0
Credits	3
Course Pre-requisite	NA
Course Objective (CO)	• The students will critically read and analyze the prescribed texts. • The students will demonstrate effective word choice, vocabulary, idioms, grammar and sentence structure allowing accurate communication of meaning in written work. • The students will recognize the correct usage of present/past/future tenses in contextualized speech.

Tales of Life:

- The Umbrella (Henry Rene Albert Guy de Maupassant)
- The Story Teller (H.H. Munro Saki)
- The Lament (Anton Pavlovich Chakhov)

Prose for Young Learners:

- Universal Declaration of Human Rights (U.N. Charter)
- Symptoms (Jerome K. Jerome)

Exploring Tenses in English:

- Present and Past
- Present Perfect and Past

Tales of Life:

- The Luncheon (William Somerset Maugham)
- The Shroud (Prem Chand)

Prose for Young Learners:

- On Spendthrifts(A.G.Gardinar)
- The Power of Women(Richard Gardon)
- A Dialogue On Democracy (Albert Sydney Horby)

Exploring Tenses in English:

- Future

Text and Reference Books

S.No.	**Author(S)**	**Year**	**Title**	**Publisher**
1	Singh, S	2008	Tales of Life	Press and Publication Department, Guru Nanak Dev University, Amritsar.
2	Tewari, A. K, Midha,V.K, Sharma, R.K	2011	Prose For Young Learners	Publication Bureau, Guru Nanak Dev University, Amritsar
3	Murphy, R	2015	English Grammar in Use	Cambridge University Press

Basics of Medical Lab Technology Lab

Course Code	**MLS103**
Course Title	Basics of Medical Lab Technology Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	10+2 Medical
Course Objective (CO)	To impart hands on practice on general laboratory procedures and techniques.

List of Experiments:

1. Measurement of liquids and weighing of solids
2. Calibration of volumetric glassware; pipettes, flasks, burettes etc.
3. To demonstrate the cleaning of lab wares and laboratory utensils
   i) Preparation of cleaning fluids (chromic acid)
4. Preparation of standard solutions (w/v, v/v, molar, normal and percent solutions)
   i) 0.1M NaOH
   ii) 0.1N HCl
   iii) 10% Nacl
5. To make suitable dilutions by diluting the standard stock solution.
6. Measurement of pH and preparation of buffer solution (any one buffer acetate or phosphate buffer)
7. To demonstrate the principle, operation, use, care and maintenance of following lab equipments:
   i) pH meter
   ii) Centrifuge
   iii) Water bath
   iv) Hot air oven
   v) Analytical Balance
8. To demonstrate the preparation of distilled and deionised water

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos.

Fundamentals of Biology Lab

Course Code	**MLS107**
Course Title	Fundamentals of Biology Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	10+2 Medical
Course Objective (CO)	To introduce basic principles and core concepts of biology, including the evolution and diversity of living organisms; cell structure and function. To impart knowledge of the staining

List of experiments

1. Study of Mitosis and Meiosis through animal cells
2. Study of Epithelial, Muscular, Neural and mammalian blood cells through permanent or temporary slides and their reasons for identification
3. Study of micrographs of different cell structures (dry lab)
4. Staining and visualization of mitochondria by Janus green stain.
5. Study of specimens of following arthropods:
   - *i) Anopheles,*
   - *ii) Culex,*
   - *iii) Aedes,*
   - *iv) Pediculus,*
   - *v) Musca*
6. Study of evolution through charts and models.
7. To demonstration process of osmosis.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos.

General Microbiology Lab

Course Code	**MLS111**
Course Title	General Microbiology Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	10+2 Medical
Course Objective (CO)	• To impart skills in essential microbiological techniques and to demonstrate the principle and working of various equipment used in microbiology • To provide hands on training to perform various microbiological tests in medical microbiology laboratory.

List of Experiments

1. To demonstrate safe code of practice for a Microbiology laboratory.
2. To prepare cleaning agents & to study the technique for cleaning & sterilization of glassware.
3. To demonstrate the theory, principle, working, maintenance and precautions of following equipments:
   i) Compound Microscope
   ii) Autoclave
   iii) Hot Air Oven
   iv) Laminar Air Flow
   v) Incubators & Shakers
4. Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa)
5. To culture bacteria by agar spread plate method.
6. To obtain isolated pure colonies using different streaking formats.
7. To prepare agar slants and agar deeps for culturing microorganisms.
8. To culture bacteria by agar pour plate method.
9. To perform a bacterial smear and perform simple staining.
10. To perform negative staining of bacteria.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Hematology - I Lab

Course Code	**MLS115**
Course Title	Hematology - I Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	10+2 Medical
Course Objective (CO)	To provide hands on training to perform various hematological procedures used as diagnostic tools for screening of hematological abnormalities.

List of Experiments

1. Study of laboratory equipments pertaining to hematological investigations.
2. Venipuncture and collection of blood samples.
3. Preparation of blood smear and staining using Geimsa stain and Leishmann stain.
4. Use of microscope for identifying blood cells.
5. Preparation of diluting fluids for RBC and WBC counts.
6. Principles of haemocytometery.
7. RBC count
8. WBC count
9. Differential Leucocyte count
10. Platelet count
11. Calculation of Red Cell Indices
12. Estimation of Haemoglobin
13. Determination of ESR

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Second Semester

Biochemistry I

Course Code	MLS102
Course Title	Biochemistry I
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	• The course intends to provide students with sufficient knowledge of structure of biomolecules and basis to understand their functions at the level of cells and body • Introduce the student to basic concepts of nutrition and its importance in biological systems.

UNIT-I

Cellular and Molecular Basis of Life: Introduction to the Chemistry of the living beings, Elementary knowledge of Cell and cell organelles: structure and function, cellular compartmentalization.

UNIT-II

Carbohydrates: Structural aspects; Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, properties of monosaccharides (Osazone formation, Pyranose & Furanose forms, mutarotation) Inter-conversion of monosaccharides and functions of carbohydrates.

Lipids: Structural aspects; General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates (elementary idea), Biological membranes, Membrane protein – structural aspects, functions of lipids, Lipoproteins: structure, types and functions.

UNIT-III

Proteins: Structural aspects – General introduction, Classification & General characteristics, Structure of Primary, Secondary, Tertiary & Quaternary proteins, Classification of Amino acids and functions of proteins

Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA, functions of DNA and RNA.

UNIT-IV

Macro and micro nutrients: Vitamins & Minerals.

Vitamins: Fat soluble vitamins and water soluble vitamins; sources, Biochemical role, RDA and Deficiency manifestations.

Minerals: Calcium, phosphorous, iron, copper, zinc, magnesium, manganese, iodine.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	Text book of Medical Biochemistry	M N Chaterjee and R. Shinde	Jaypee Brothers Medical Publishers(P) Ltd.
2	Principal of Biochemistry	A.Lehninger	WH Freeman Publisher & Co.
3.	Biochemistry	U. Satayanarayana and U. Chakarpani	Reed Elsevier India Pvt. Ltd
4.	Biochemistry	Voet & Voet	John Willey
5.	Practical Biochemistry	D. Plummer	Tata McGraw Hill
6.	Harper's Bio Chemistry	Robert K. Murray, David A. Bender, Kathleen M. Gotham, Peter J. Kennelly, victor W. Rodwell & P.Anthony.Weil.	McGraw Hill

Human Anatomy & Physiology-I

Course Code	**MLS106**
Course Title	Human Anatomy & Physiology-I
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	• To identify and relate basic concepts of structure and function of cells, tissues and organs. • To understand the anatomical organization, coordination and integrated functions of human body.

UNIT-I

General anatomy: Introduction to anatomical terms and organization of the human body, Definition of anatomy and its divisions, Terms of location, positions and planes.

Tissues –Definitions, Types, characteristics, classification, location and functions.

UNIT-II

Musculoskeletal system: Bones – types, structure**,** Bone formation and growth, Axial & appendicular skeleton, Joints–classification and structure, Types and structure of skeletal muscles, mechanism of muscle contraction, isotonic and isometric contractions, energy sources of muscle contractions, motor UNIT, Movements at the joints and muscles producing movements.

UNIT-III

Cardiovascular System: Circulatory system – Structure of the Heart, Structure of Blood Vessels – arterial and venous system. Anatomy of heart, cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG – methods of recording and ECG waves. Normal values of blood pressure, heart rate and their regulation in brief.

Structure and Functions of Blood: Components, names of developmental stages of RBC, functions and fate of RBC, functions of WBC and platelets, Basis of blood coagulation and blood groups – ABO & Rh.

Lymphatic System: Gross and microscopic structure of lymphatic tissue - lymph vessels and lymph nodes, functions of lymph, structure and function of thymus and spleen.

UNIT-IV

Respiratory System: Parts; Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura, Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs, transport of oxygen and carbon dioxide, brief account of respiratory regulation, Definition of hypoxia, Cyanosis and asphyxia, Methods of artificial respiration.

Digestive System: Parts of alimentary canal, structure and functions of tongue, pharynx, oesophagus, stomach, small and large intestine and anus, principles of secretion and movements of gastrointestinal tract. (G.I tract)

Digestive Glands: Structure and function of Salivary glands, liver and pancreas, functional anatomy of G.I.T and functions of G.I secretions.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Anatomy & Physiology- Ross and Wilson	Anne Waugh & Allison Grant	Churchill Living Stone
2	Anatomy and Physiology: Understanding the Human Body	Robert Clark	Jones & Bartlett publishers
3.	Functional Histology	James S. lowe, Barbara young, Allen Stevens & John W heath	Elsevier
4.	Text book of human Histology with color Atlas and Practical Guide	Inderjit singh	Jaypee Brothers Medical publishers
5.	Understanding Human Anatomy and Physiology	Willium Davis	McGraw Hill

Pathology – I (Medical Parasitology)

Course Code	**MLS110**
Course Title	Pathology – I
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	The course is intended to impart knowledge related to geographical distribution, morphology, life history and pathogenesis of medically important parasites. Students will also learn the techniques pertaining to their diagnosis.

UNIT-I

Introduction: General characteristics of parasites, types of parasites, hosts of parasites, host-parasite relationship, Routes of transmission, organs and tissues affected by parasites, host response to parasite infections, Role of vectors in transmission of parasites

UNIT-II

Diagnosis of parasitic infections: Gross and microscopic examination of stool samples, sedimentation and floatation methods, Blood examination

Protozoan parasites: Introduction and classification of protozoa, Morphology, life cycle and laboratory diagnosis of *Entamoeba histolytica, Giardia lamblia, Trichomonas vaginalis*

Intracellular protozoan parasites: Morphology, life cycle and laboratory diagnosis of *Trypanosoma brucei gambiense, Leishmania donovani*.

UNIT-III

Malaria parasite: Morphology, life cycle and laboratory diagnosis of *Plasmodium vivax, P. ovale, P. malariae, P. falciparum*

Cestodes: General characteristics and classification of cestodes, morphology, life cycle and laboratory diagnosis of *Taenia saginata, Taenia solium,*

Trematodes: General characteristics and classification of trematodes, morphology, life cycle and laboratory diagnosis of *Schistosoma haematobium* and *Fasciola hepatica*

UNIT-IV

Nematodes- I: General characteristics and classification of nematodes, morphology, life cycle and laboratory diagnosis of *Ascaris lumbricoides* and *Ancyclostoma duodenale*

Nematodes-II: Morphology, life cycle and laboratory diagnosis of *Enterobius vermicularis, Wuchereria bancrofti*

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Medical parasitology	D. Arora	CBS Publishers
2	Parasitology	Chaterjee	CBS Publishers
3	Medical Parasitology	RL Ichhpujani and Rajesh Bhatia	Jaypee brothers Medical Publishers
4.	Text book of Parasitology	NC Dey & D Sinha	New central book agency
5.	Oxford handbook of clinical pathology	James carton	Oxford handbook of clinical pathology
6.	Medical Microbiology	Paniker &Satish Gupte	Universities press

Hematology – II

Course Code	MLS114
Course Title	Hematology – II
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	This subject aims to enable the students to carry out routine clinical laboratory investigation (blood, urine etc). He/she should be able to provide technical help for sophisticated hematological techniques with adequate knowledge of various principles.

UNIT-I

Hematopoiesis: Overview, Regulation of erythrocyte production, distribution morphology, kinetics of haemoglobin synthesis, Haemoglobin: structure, function, normal and abnormal haemoglobin pigments and their measurement, Leucopoiesis: WBC production, distribution, morphology, kinetics**,** Thromopoiesis: Platelet Production, distribution, morphology, kinetics.

UNIT-II

Blood Coagulation: Theories of blood coagulation, Normal haemostatic mechanism, Classification of coagulation factors, Physiological properties of various coagulation factors, Preparation of various coagulation reagents such as Tissue Thromboplastin, Cephalin, Kaolin and Thrombin

Haemostasis: Investigation of haemostatic mechanism: BT, CT, whole blood coagulation time test, PT, PTT, Platelet function tests, Screening coagulation tests such as Bleeding and clotting Time, Hess test, prothrombin time (PT) and Activated Partial Thromboplastin time (APTT).

UNIT-III

Hematological Disorders: Anemias - Classification and approach to diagnosis and diagnostic tests, Polycythemias, Neoplastic and non-neoplastic disorders of WBC, Classification and lab diagnosis of leukemias, chronic myeloproliferative disorders and other malignant disorders of the haemopoietic system.

UNIT-IV

Quantitative and qualitative abnormalities and inherited and acquired disorders of platelets

Automation: Introduction to automation in hematology, Principle, advantages, cautions and types of autoanalysers.

Quality assurance and quality control

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
2.	Hand book of Medical Laboratory Technology (2nd Ed)	V.H. Talib	CBS Publishers & Distributors
3.	Medical Laboratory Technology Methods & Interpretation (5th Ed)	Ramnik Sood	Jaypee Brothers Medical publishers
4.	A Manual of Laboratory & Diagnostic Tests (6^{th} Ed)	Frances Fischbach	Lippin Cott wiliam & wilkins
5.	Hematology (Pathophysiological basis for clinical practices)	Paul R Reich and Stephen M. Robinson	Lippin Cott wiliam & wilkins

General English-II

Course Code	ENG102
Course Title	General English
Type Course	Theory
L T P	3 0 0
Credits	3
Course Pre-requisite	NA
Course Objective (CO)	To develop understanding of the significance of English as a subject in the present context, to feel pleasure and to develop the understanding of the significance of basic competencies in language acquisition. This course will enable students to understand the foreign language as well as the use of language and to enable students to acquire language skills such as listening, speaking, reading, and writing and integrate them for communicative purposes.

Texts Prescribed:

1. Tales of Life
    - The Doll's House(Katherine Mansfield)
    - Eveline (James Joyce)
    - Toba Tek Singh (Saadat Hassan Manto)
    - The Taboo (Victor Astafyev)
    - A Strand of Cotton (Suneet Chopra)

2. Prose for Young Learners
    - Beauty And The Beast(R.K.Narayan)
    - With A Song On Their Lips (Hugh & Colleen Gantzer)
    - My Financial Careers (Stephen Leacock)
    - The School For Sympathy (E.V. Lucas)
    - AIDS (U.N.Report)

3. Exploring Grammar
4. Modals
5. Passive
6. Reported Speech
7. Questions and Auxiliary verbs

Text and Reference Books

S. No.	Author(S)	Year	Title	Publisher
1	Singh, S	2008	Tales of Life	Press and Publication Department, Guru Nanak Dev University, Amritsar.
2	Tewari, A. K, Midha,V.K, Sharma, R.K	2011	Prose For Young Learners	Publication Bureau, Guru Nanak Dev University, Amritsar
3	Murphy, R	2015	English Grammar in Use	Cambridge University Press

Biochemistry –I Lab

Course Code	**MLS104**
Course Title	Biochemistry –I Lab
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	10+2 Medical
Course Objective (CO)	To make students familiar with the techniques of qualitative and quantitative analysis of biologically important compounds such as sugars, aminoacids, proteins and lipids etc.

List of Experiments:

1. Qualitative analysis of carbohydrates (atleast one test for each aldo, keto sugar, reducing sugars and non-reducing sugars)
   Molisch, Fehling, Benedict, Seliwanofft, Barfoed and Iodine test
2. Qualitative analysis of aminoacids and proteins:
   Biuret, Millon`s, ninhydrin, xanthoprotic tests
3. General tests for lipids:
   Solubility test, emulsification test, Sudan-III test
4. Preparation of common anticoagulants used in laboratory.
5. Verification of Lambert-Beer's Law Spectrophotometrically
6. Quantitaive estimation of sugars by
   a) Dubois method
   b) Anthrone method
   c) DNS method
7. Quantitaive estimation of proteins by
   a) Biuret method
   b) Folin-lowry`s method

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.

Human Anatomy & Physiology Lab

Course Code	**MLS108**
Course Title	Human Anatomy & Physiology Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	10+2 Medical
Course Objective (CO)	Students will be able to learn the basic terminology of anatomy, architecture and functional details of cells, tissues, organs and organ systems.

List of Experiments

1. Study of following body systems showing all parts through charts and models:

    a) Musculo-skeletal system: bones and joints
    b) Cardiovascular system: heart, artery and vein, blood circulation
    c) Respiratory system: trachea and lungs
    d) Digestive system: parts of alimentary canal and digestive glands

2. Study of histology of following from permanent slides:

    a) Types of epithelial tissue
    b) Skeletal, smooth & cardiac muscle (TS & LS)
    c) Compact bone (TS & LS)
    d) Cartilages (hyalin, elastic and fibro-cartilage)
    e) Artery & vein (TS)
    f) Spleen (TS)
    g) Oesophagus (TS)
    h) Stomach (TS)
    i) Deudenum (TS)
    j) Liver (TS)
    k) Pancreas (TS)

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.

Pathology -I Lab

Course Code	**MLS112**
Course Title	Pathology -I Lab
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	10+2 Medical
Course Objective (CO)	The students will learn techniques related to collection, transportation and preservation and processing of specimens for routine parasitological investigations.

List of experiments:

1. Routine stool examination for detection of intestinal parasites: Preparation of slide; Saline and Iodine mount
2. Concentration methods: simple floatation, Lane`s direct centrifugal floatation. Zinc sulphate centrifugation
3. Sedimentation method: simple sedimentation and Formal ether concentration method
4. Microscopic detection of parasite life stages (eggs, cysts, adult worms, larvae) in sputum sample
5. Detection of different stages of Plasmodium species in permanent slides of blood sample.
6. Detection of malaria parasites in peripheral blood smear by Giemsa staining
7. Identification of adult worms from Model/specimens/slides: (morphology, stages of life cycle, pathogenicity and clinical features)
    a) *T. solium and T. saginata*
    b) *Ascaris lumbricoides*
    c) Pinworms
8. Detection of different stages of *Plasmodium* species in permanent slides of Blood sample
9. Detection of malaria parasites in peripheral blood smear by Giemsa staining
10. Detection of malaria parasites in peripheral blood smear by Leishman's stain

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonsStrated through any other material or medium including videos

Hematology – II Lab

Course Code	**MLS116**
Course Title	Hematology – II Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	10+2 Medical
Course Objective (CO)	To impart hands-on training for identifying blood cell abnormalities for the diagnosis of disease and to provide skills necessary to perform blood cell count and evaluation of blood elements within stated limits of accuracy

List of Experiments

1. Basic steps for drawing a blood specimen by vein puncture and Complications of vein puncture.
2. Theory of hemolysis
3. Blood collection by skin puncture (Capillary Blood)
4. Deciding specimen types and selection of - Anticoagulant- EDTA, Citrate, Oxalate, Heparin, sodium fluoride.
5. Preparation of thin, thick, & wet blood films.
6. Packed cell volume
7. Erythrocyte Indices- MCV, MCH, MCHC.
8. Reticulocyte Count.
9. Absolute Eosinophil Count
10. Estimation of serum iron

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Third Semester

Biochemistry – II

Course Code	MLS201
Course Title	Biochemistry – II
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	DMLT / B.Sc MLS / B.Sc MLT – I
Course objectives	The course aims to provide students with a basic understanding of principles of bioenergetics and enzyme catalysis, metabolism of dietary and endogenous carbohydrate, lipid, and protein and major mechanisms of metabolic control.

UNIT-I

Principle of intermediary metabolism: catabolism and anabolism, Biological oxidations & electron carriers and general concept of metabolic regulation.

UNIT-II

Carbohydrate metabolism: Digestion and absorption of carbohydrates, major catabolic routes of glucose; glycolysis, TCA, glycogenolysis & HMP shunt pathway, anaerobic breakdown of glucose (alcoholic and lactic acid fermentation), anabolism of carbohydrates; gluconeogenesis and glycogenesis, regulation of blood glucose (homeostasis) and metabolic disorders of carbohydrate metabolism

Lipid metabolism: Digestion and absorption of lipids, role of lipoproteins in transportation of lipids, fatty acid oxidation, ketone body formation and ketosis, fatty acid synthesis, metabolism of cholesterol (biosynthesis and degradation), bile acids and their functions, disorders of lipid metabolism.

UNIT-III

Protein Metabolism: Digestion and absorption of proteins, catabolism of amino acids; Deamination, Transamination and Decarboxylation reactions, transport of ammonia and Urea cycle, biosynthesis of amino acids (elementary idea), metabolic disorders of aminoacids and proteins.

Metabolism of nucleic acids: Catabolism and biosynthesis of nucleotides, nucleosides and purine and pyrimidine bases, clinical disorders of purine and pyrimidine metabolism.

UNIT-IV

Enzymes: Nomenclature and classification of enzymes, general properties of enzymes; specificity, mechanism of action (Lock and key & induced fit hypothesis) and factors affecting enzyme action

Enzyme kinetic: Michaelis-Menten equation, significance of Km, enzyme inhibition and enzyme regulation.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Biochemistry	Voet & Voet	John Willey
2	Biochemistry	Lubert Stryer, Jeremy Berg & John L tymoczko	WH Freeman & Co.
3	Harper's Bio Chemistry	Robert K Murray, David A	McGraw Hill

		Bender, Kathleen M. Gotham, Peter J Kennelly, victor W.Rodwell & P.Anthony.Weil.	
4	Principles of Biochemistry	David.L Nelson & Albert Lehninger	WH Freeman Publisher & Co.
5.	Text book of Medical Biochemistry	M N Chaterjee and R. Shinde	Jaypee Brothers Medical Publishers(P) Ltd.
6.	Practical Biochemistry, 3rd Ed.	D. T. plummer	Mc Graw Hill

Human Anatomy & Physiology-II

Course Code	**MLS205**
Course Title	Human Anatomy & Physiology-II
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	DMLT / B.Sc MLS / B.Sc MLT-I
Course objective	Students will learn the concepts of anatomical structures in relationship to their physiological functions. They will also learn the integration and coordination of body functions and their dependence on endocrine and nervous system to regulate the physiological activities.

UNIT-I

Urinary System: Parts, Gross structure of kidney, ureters, urinary bladder and urethra, structure of nephron, measurement and regulation of GFR and mechanism of urine formation.

UNIT-II

Reproductive System: Parts of the system, gross structure of both male and female reproductive organs, reproductive cycle in female including menstrual cycle, pregnancy, parturition, lactation, male sex hormones and spermatogenesis and Basis of contraception.

UNIT-III

Nervous System: Structure of neuroglia and neurons, nerve impulse, myelinated and non-myelinated nerve parts and classification:

CNS – Structure of Brain and spinal cord and their functions.

PNS - Cranial nerves and spinal nerves

ANS - Sympathetic and Parasympathetic

Brief account of resting membrane potential, action potential and conduction of nerve impulse across synapse and neuromuscular junction and role of neurotransmitters

Sensory Organs: Structure and functions of Skin, Eye, Nose, Ear and Tongue (Auditory and Olfactory apparatus)

UNIT-IV

Endocrine System: Gross structure of pituitary, thyroid, parathyroid, pancreas and adrenal glands, Names of endocrine glands - their secretions and functions, Brief account of endocrine disorders.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Anatomy & Physiology- Ross and Wilson	Anne Waugh & Allison Grant	Churchill Living Stone
2	Anatomy and Physiology: Understanding the Human Body	Robert Clark	Jones & Bartlett publishers
3	Anatomy and Physiology for nurses	Evelyn Pearce	Faber & Faber

4.	Functional Histology	James S. lowe, Barbara young, Allen Stevens & John W heath	Elsevier
5.	Text book of human Histology with color Atlas and Practical Guide	Inderjit singh	Jaypee Brothers Medical publishers
6.	Understanding Human Anatomy and Physiology	Willium Davis	Mc Graw Hill

Pathology – II (Systematic Bacteriology)

Course Code	**MLS209**
Course Title	Pathology – II (Systematic Bacteriology)
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	DMLT/ B.Sc MLS / B.Sc MLT-I
Course objective (CO)	To impart the knowledge of causative agents, pathogenesis, biochemical assays and lab diagnosis for characterization of pathogenic bacteria.

UNIT-I

Pathogenic Gram-positive cocci: Morphology, culture characteristics, biochemical features and laboratory diagnosis of *Staphylococus aureus, Streptococcus pyogenes* and *Streptococcus pneumoniae.*

Pathogenic Gram-negative cocci: Morphology, culture characteristics, biochemical features and laboratory diagnosis of *Neisseria gonorrhoeae* and *Neisseria meningitides*

UNIT-II

Pathogenic Gram-negative bacilli-I: Morphology, culture characteristics, biochemical features and laboratory diagnosis of *Hemophilus influenzae*, Pathogenic *E. coli* and *Salmonella typhi*

Pathogenic Gram-negative bacilli-II: Morphology, culture characteristics, biochemical features and laboratory diagnosis of *Helicobacter pylori, Shigella dysenteriae*

UNIT-III

Pathogenic Gram-positive bacilli-I: Morphology, culture characteristics, biochemical features and laboratory diagnosis of *Corynebacterium diptheriae, Clostridium tetani* and *Clostridium botulinum*.

Pathogenic Gram-positive bacilli-II: Morphology, culture characteristics, biochemical features and laboratory diagnosis of *Listeria monocytogenes* and *Bacillus anthracis*

UNIT-IV

Other pathogenic bacteria: Morphology, culture & biochemical features and laboratory diagnosis of *Mycobacterium tuberculosis, Vibrio cholerae.*

Mycoplasmas and rickettsias: Morphology, culture & biochemical features and laboratory diagnosis of *Mycoplasma pneumoniae* and *Chlamydia trachomatis*

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Clinical Pathology and Bacteriology 8th Ed,	K.N. Sachdev	J.P. Bros, New Delhi 91.
2	Text book of Microbiology	Ananthanereyan And Paniker's Text Book of Micrbiology	Universities Press
3.	Text book of Microbiology	Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg	Tata McGraw Hill
4.	Clinical Diagnosis &Management by Laboratory methods (20th edition)	John Bernard Henary	Sounder Publisher
5.	Medical laboratory Technology Volume-I	KL Mukherjee	Tata Mcgraw Hill

Basics of Biochemical & Biophysical Techniques

Course Code	**MLS213**
Course Title	Basics of Biochemical & Biophysical Techniques
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	DMLT / B.Sc MLS / B.Sc MLT –I
Course Objective (CO)	• To provide insights into the complex biochemical and biophysical principles and procedures used for extraction, separation, purification, estimation and characterization of compounds of clinical importance in analytical biochemistry. • To impart knowledge about radio diagnostic techniques.

UNIT-I

Spectrophotometry: Introduction, theory, principle and applications of spectrophotometry, applications and limitations of Lambert Beer's law, types (single and double beam) and operational use of Spectrophotometers.

AAS: Introduction to principle, instrumentation and applications of atomic absorption spectrophotometers.

UNIT-II

Colorimetry: Theory, principle and applications of photo colorimeter, Introduction to optical filters, operational use and limitations of colorimeters.

Flame photometry: Principle, instrumentation and applications of flame photometers in clinical sciences.

UNIT-III

Chromatography: Basic Principle, theory, modes and types of chromatographic techniques, Principle, procedure and applications of paper chromatography, TLC, column chromatography (LPLC & HPLC), ion exchange chromatography, Gas chromatography and gel exclusion chromatography.

Centrifugation: Basic principles, theory and applications of preparative and analytical centrifugation, rotor types, sedimentation co-efficient, care and maintenance of rotors.

UNIT-IV

Radioisotopic Techniques: Basic concepts of radioisotopy- decay constant, decay series, theory and applications of Geiger-Muller tube counter, solid and liquid scintillation counters, primary and secondary fluors, safety rules for radioisotopic studies, radiosiotopes used in medicine.

Electrophoresis: Basic principles, theory and application of native, SDS-PAGE and agarose gel electrophoresis, Introduction to IEF (Iso-electric focusing) 2-D gel electrophoresis and its applications in diagnosis.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd edition	D. Freifelder (1982)	W.H. Freeman & Company
2	Biologist's Guide to Principles and Techniques of Practical Biochemistry. 3rd.	Wilson, K and Goulding, K.H. (1991).	Edward Arnold, London.
3	Introductory Practical Biochemistry	Sawhney, S.K. and Singh, R. (2001)	Narosa Publishing House, New Delhi
4.	Principles and Techniques of Practical Biochemistry and Molecular Biology, 7th Edition	Wilson, K and Walker, .J (2010)	Cambridge University Press, New Delhi

Environmental Science

Course Code	**EVS101**
Course Title	Environmental Science
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	NA
Course objective	To make students aware about environment and need of maintaining it with best possible knowledge.

Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies, Disaster Management: Floods, earthquake, cyclone and landslides.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness

Human Population and the Environment: Population growth, variation among nations. Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies

Field Work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain; Visit to a local polluted site-Urban/Rural/Industrial/Agricultural; Study of common plants, insects, birds; Study of simple ecosystems-pond, river, hill slopes, etc.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1	A Textbook for Environmental Studies	Erach Bharucha	
2	Environmental Biology,	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner.
3	Environmental Science,	Miller T.G. Jr.	Wadsworth

Biochemistry – II Lab

Course Code	**MLS203**
Course Title	Biochemistry – II Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT-I
Course objective	To provide hands on training on routine biochemical estimations including enzyme activity measurements carried out in medical laboratory.

List of experiment

1. Estimation of blood Glucose by
    - Folin Wu method
    - Glucose oxidase method.
2. Determination of Total serum proteins.
3. Determination of Uric acid in serum or plasma
4. Determination of Urea in serum or plasma
5. Determination of total Cholesterol in serum or plasma
6. Determination of enzyme activity of salivary amylase or acid phosphatase
7. To study effect of pH on enzyme activity
8. To study effect of temperature on enzyme activity

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Human Anatomy & Physiology-II Lab

Course Code	**MLS 207**
Course Title	Human Anatomy & Physiology-II Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –I
Course objective	The concepts related to anatomical details of human organ systems and integration and coordination between them will be demonstrated through charts, models and permanent slides.

List of Experiments

1. Study of following body systems showing all parts through charts and models

    a) Excretory system: kidney, ureters and urinary bladder
    b) Male reproductive system: Testes and vas deferens
    c) Female reproductive system: ovaries, uterus, fallopian tubes
    d) Nervous system: parts of brain; cerebellum, cerebrum, Pons and medulla oblongata

2. Study of histology of following tissues and organs from permanent slides:

    a) Kidney (LS)
    b) T.S of cortex part of kidney
    c) T.S of medulla part of kidney
    d) T.S of testes
    e) T.S of ovaries
    f) myelinated and non-myelinated nerve fibres
    g) T.S of spinal cord
    h) Thyroid gland (TS)
    i) Adrenal gland (TS)
    j) Pancreas (TS)

3. Study of structure of various sensory organs from charts.

    a) Eye
    b) Ear
    c) Nose

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Pathology-II Lab

Course Code	**MLS211**
Course Title	Pathology-II Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT-I
Course objective	To provide hands on training on techniques related to characterization and lab diagnosis of medically important bacteria.

List of Experiments:

1. To perform Gram staining of different bacterial cultures
2. To perform Ziehl-Neelsen staining of bacteria
3. To perform Alberts staining of bacteria
4. Processing of blood sample for culture and identification of pathogen.
5. Processing of urine sample for culture and identification of pathogen.
6. Processing of Sputum sample for culture and identification of pathogen
7. Processing of Pus sample for culture and identification of pathogen
8. To perform Indole production, Methyl red, Voges-Proskauer and citrate utilization tests for biochemical charecterization of bacteria.
9. To perform urease, catalase and oxidase tests for biochemical characterization of bacteria.
10. To perform motility Test of a Bacteria: by Hanging Drop Preparation
11. Antibiotic sensitivity testing.
12. Serological tests:
    a) Widal,
    b) HBsAg /anti HIV detection.
    c) CRP

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Basics of Biochemical and Biophysical Techniques Lab

Course Code	**BML215**
Course Title	Basics of Biochemical and Biophysical Techniques Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT-I
Course Objective (CO)	To provide hands-on training on operational use of various equipments such as spectrophotometers, flame photometers, electrophoretic UNITs etc. used in analytical techniques.

List of Experiments:

1. Demonstration of principle, working & maintenance of spectrophotometer.
2. Preparation of standard curve by measurement of the transmission of light through different solutions or substances at different wavelengths of light.
3. Demonstration of principle, working & maintenance of colorimeter.
4. Demonstration of principle, working & maintenance of flame photometer.
5. To demonstrate the separation of aminoacids by paper chromatography.
6. To demonstrate the principle & demonstration of TLC.
7. To demonstrate theory, principle and procedure for preparation of agarose and polyacrylamide gels.
8. To demonstrate the principle and procedure for separation of proteins on SDS-PAGE.
9. Demonstration of serum electrophoresis.
10. To demonstrate the principle and working of centrifuges.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Basics of Computers Lab

Course Code	**CSE213**
Course Title	Basics of Computers Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	NA
Course Objective (CO)	

List of practicals

1. Given a PC, name its various components and peripherals. List their functions
2. Practice in installing a computer system by giving connection and loading the system software and application software
3. Exercises on entering text and data (Typing Practice)
4. **Installation of operating System viz. Windows XP, Windows 2007 etc.**

   Features of Windows as an operating system
   - Start
   - Shutdown and restore
   - Creating and operating on the icons
   - Opening closing and sizing the windows
   - Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file
   - Creating and operating on a folder
   - Changing setting like, date, time, colour (back ground and fore ground)
   - Using short cuts
   - Using on line help
5. **Word Processing (MS Office/Open Office)**
   a) File Management:
      Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file
   b) Page Set up:
      Setting margins, tab setting, ruler, indenting
   c) Editing a document:
      Entering text, Cut, copy, paste using tool- bars
   d) Formatting a document:
      Using different fonts, changing font size and colour, changing the appearance through bold/ italic/ underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
      Aligning of text in a document, justification of document, Inserting bullets and numbering
      Formatting paragraph, inserting page breaks and column breaks, line spacing
      Use of headers, footers: Inserting footnote, end note, use of comments

Inserting date, time, special symbols, importing graphic images, drawing tools

e) Tables and Borders:
Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
Print preview, zoom, page set up, printing options
Using Find, Replace options

f) Using Tools like:
Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelops and lables
Using shapes and drawing toolbar,
Working with more than one window in MS Word,
How to change the version of the document from one window OS to another
Conversion between different text editors, software and MS word

6. **Spread Sheet Processing (MS Office/Open Office)**

a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, create chart, printing chart, save worksheet, switching between different spread sheets

b) Menu commands:
Create, format charts, organise, manage data, solving problem by analyzing data, exchange with other applications. Programming with Excel Work Sheet, getting information while working

c) Work books:

Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations, working with arrays

a) Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet

b) Creating a chart:

c) Working with chart types, changing data in chart, formatting a chart, use chart to analyze data

d) Using a list to organize data, sorting and filtering data in list

e) Retrieve data with query: Create a pivot table, customising a pivot table. Statistical

f) analysis of data

g) Exchange data with other application: embedding objects, linking to other applications, import, export document.

7**. PowerPoint Presentation (MS Office/Open Office)**

a) Introduction to PowerPoint

- How to start PowerPoint
- Working environment: concept of toolbars, slide layout, templates etc.
- Opening a new/existing presentation
- Different views for viewing slides in a presentation: normal, slide sorter etc.

b) Addition, deletion and saving of slides

c) Insertion of multimedia elements

- Adding text boxes
- Adding/importing pictures
- Adding movies and sound
- Adding tables and charts etc.
- Adding organizational chart

d) Formatting slides

- Using slide master

- Text formatting
- Changing slide layout
- Changing slide colour scheme
- Changing background
- Applying design template

e) How to view the slide show?

- Viewing the presentation using slide navigator
- Slide transition
- Animation effects etc.

8. **Working with Data Processing (MS Office/Open Office)**
   a) Understanding different data types
   b) Creation of table
   c) Entering data in a table and modify it.
   d) Creating simple Queries
9. **Internet and its Applications**
   a) Log-in to internet
   b) Navigation for information seeking on internet
   c) Browsing and down loading of information from internet
   d) Sending and receiving e-mail
   - Creating a message
   - Creating an address book
   - Attaching a file with e-mail message
   - Receiving a message
   - Deleting a message

Fourth Semester

Clinical Biochemistry

Course Code	MLS202
Course Title	Clinical Biochemistry-I
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc MLS / B.Sc MLT-III sem
Course Objective (CO)	The course is intended to make the students familiar with various methods of clinical sample analysis for biochemical parameters which are the basis for diagnosis of various diseases.

UNIT-I

Introduction to Clinical laboratory: Laboratory organization, management and maintenance of records, Hazards & safety measures in clinical biochemistry laboratory, Quality control and quality assurance.

UNIT-II

Acid base balance concepts & disorders - pH, buffers, acidosis and alkalosis: types, causes and health complications.

UNIT-III

Routine biochemical investigations: Principles, assay procedures, Normal range in blood, Serum, Plasma and Urine, reference values and clinical significances of following:

- Glucose
- Proteins
- Urea
- Uric acid
- Creatinine
- Bilirubin
- Cholesterol
- Sodium
- Potassium
- Chloride,
- Iodine
- Calcium
- Phosphorous

UNIT-IV

Examination of Body fluids & glycemic disorders:

Chemical examination of Urine: composition of urine, collection, preservation and changes in composition of urine in relation to various diseases.

Cerebrospinal fluid: composition, collection and preservation, physical and chemical examination of CSF.

Hyperglycemia & hypoglycaemia: Diabetes mellitus - definition, types, features, gestation diabetes mellitus, glucose tolerance test, Causes of glycosuria & hypoglycemia.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
2	Medical laboratory Technology Volume-III (2nd Ed.)	KL Mukherjee	Tata McGraw Hill
3	Practical Clinical Biochemistry	Harold Varley	CBS Publishers & Distributers
4	Text book of Medical Biochemistry	M N Chaterjee and R. Shinde	Jaypee Brothers Medical Publishers(P) Ltd.
5.	Medical Laboratory Sciences, Theory & Practical	Arundhati Kolhatkar & J. ochei	McGraw Hill

Hematology – III

Course Code	MLS206
Course Title	Hematology – III
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc MLS / B.Sc MLT – III sem
Course Objective (CO)	The course has been designed to provide students knowledge related to principle of tests, methodology of routine as well as advanced procedures being carried out in the laboratory by using routine as well as sophisticated instruments. Stress is also given in use of safety measures in the laboratory

UNIT-I

Special Hematological tests: Principle, procedures, normal values and clinical significance of following hematological tests:

- Sickling tests
- Osmotic fragility test
- Determination of HbF and HbA2
- Haemoglobin Electrophoresis
- Investigation of Glucose-6-phosphate dehydrogenase deficiency
- Plasma haptoglobin and demonstration of hemosiderin in urine
- Tests for Autoimmune haemolytic anaemia
- Measurement of abnormal Hb pigments
- Laboratory diagnosis of protozoon blood parasites
- Preparation and staining of Heinz body
- Preparation and demonstration of Lupus erythematosus (LE) cell

UNIT-II

Immuno-hematology: Principles of immunohematology**,** Human blood group systems (basic genetics of ABO & Rh blood group systems)
Methods of blood group typing: saline method, albumin displacement technique and enzyme techniques.

UNIT-III

Bone Marrow Examination: Composition and functions**,** Bone marrow aspiration, Preparation of bone marrow smear for microscopic examination

UNIT-IV

Staining methods- Romanowsky stains.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
2.	Hand book of Medical Laboratory Technology (2nd Ed)	V.H. Talib	CBS Publishers & Distributors
3.	Medical Laboratory Science – Theory and Practice	J. Ochei & A Kolhatkar	Mcgraw Hill
4.	Practical Hematology (8th Ed)	Sir John V Dacie & S Mitchell Lewis	Churchill Living Stone
5.	Clinical Hematology	Christopher A. Ludlam	Churchill Living Stone
6.	Clinical Diagnosis &Management by Laboratory methods (20th Ed)	John Bernard Henary	Sounder Publisher
7.	A Manual of Laboratory & Diagnostic Tests (6th Ed)	Frances Fischbach	Lippin Cott wiliam & wilkins

Pathology – III ((Mycology)

Course Code	MLS210
Course Title	Pathology – IV (Mycology)
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	B.Sc MLS / B.Sc MLT –III sem
Course Objective (CO)	To impart the knowledge about identification of various fungal infections and diagnosis of microbial infections by serological methods.

UNIT-I

Mycology: Introduction, general characteristics, classification and medically important fungi, nomenclature, diseases and their characteristics

UNIT II

Identification and sensitivity: Staining techniques, culture media, laboratory contaminants, chemotherapeutic agents for fungi

UNIT-III

Superficial mycoses: Pathogenesis and laboratory diagnosis of *Tinea versicolor, Tinea nigra, Piedra,* and *Dermatophytoses*

Subcutaneous mycoses: Pathogenesis and laboratory diagnosis of *Mycetoma, sporotrichchosis, Rhinosporidiosis*

UNIT IV

Systemic mycoses: Pathogenesis and laboratory diagnosis of *Candidiasis, Cryptococcosis, Penicillosis* and *Aspergillosis,*

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Microbiology	Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg	Tata McGraw Hill
2	Text book of Microbiology	Ananthanereyan And Paniker's Text Book of Micrbiology	Universities Press
3	Medical Microbiology	Paniker &Satish Gupte	Universities Press

Basic Virology

Course Code	MLS210
Course Title	Basic Virology
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	B.Sc MLS / B.Sc MLT –III sem
Course Objective (CO)	To impart the knowledge of collection of samples, their processing and identification of viral infections

UNIT-I

Introduction to medical virology: Nomenclature, classification and general properties (physical, chemical and biological), and general laboratory diagnosis of viral diseases

UNIT-II

DNA and RNA viruses: mode of infection, spread, laboratory Diagnosis of Polio, Influenza, Para influenza, mumps, Measles, Rubella, Respiratory syncital, Rota, Hepatitis, arbo viruses prevalent in India (Dengue, West Nile, Japanese Encephalitis, KFD), Chicken pox, Adeno, Papova, Herpes, HIV, Cytomegalo viruses etc.

UNIT-III

Laboratory collection and processing: Collection, transportation, processing and storage of samples for viral diagnosis

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Microbiology	Michael J. Pelczar, JR. E.C.S Chan & Noel R. Krieg	Tata McGraw Hill
2	Text book of Microbiology	Ananthanereyan And Paniker's Text Book of Micrbiology	Universities Press
3	Medical Microbiology	Paniker &Satish Gupte	Universities Press

Concepts in Immunology & Immunological Techniques

Course Code	MLS214
Course Title	Concepts in Immunology & Immunological Techniques
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc MLS / B.Sc MLT –III sem
Course Objective (CO)	The student will learn the basics of immunology including structural components, their functions and underlying mechanisms.

UNIT-I

Overview to Immunology: Types of immunity: innate and adaptive, lymphoid cells, heterogeneity of lymphoid cells; T- Cells; B-Cells, null Cells; monocytes, polymorphs, primary and secondary lymphoid organs.

Humoral response: Antigen and Antibody and their characteristics, primary and secondary immune response and effector mechanism.

UNIT-II

Antigen-antibody interaction: general features, mechanisms and applications of various antigen-antibody interaction techniques.

Celll mediated Immunity: Role of MHC in cell mediated IR, T-cell receptor complex and effector mechanism., **Immunity to infectious diseases, Tumour Immunology and Immunology of AIDS**

UNIT-III

Immunotechnology: Precipitation and agglutination reactions: bacterial haemagglutination haemagglutination inhibition; Immuno-diffusion (Radial and double diffusion) and electro-immunodiffusion, Immunoelectrophoresis, Radioimmuno assay, ELISA and immunohistochemical staining methods.

UNIT-IV

Immunity to virus, intracellular and extracellular bacteria, immunopathological consequences of parastitic infections, immune invasion mechanism used by parasites.

Vaccines: conventional vaccine, viral vaccines, bacterial vaccines, peptide vaccines, genetically engineered vaccines, DNA vaccines.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Immunology, 5th Edition.	Kuby, J.	W.H. Freeman and Company, New York
2	Roitt`s Essentials Immunology, 4th Edition	Roitt, I.M. Brostoff, J. and Male, D.K.	Grower Medical Publishing , New York
5.	Cell and Molecular Biology	De-Robertis, F.D.P. and De-Robertis Jr. E.M.F.	Saunders publishers, Philadelphia

Course Code	MLS218
Course Title	Histopathology and Histopathological techniques
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc MLS / B.Sc MLT – III sem
Course Objective (CO)	To study pathologically altered structure and function of diseased cells, tissues and organs To understand the importance of tissue as a key resource for investigation and to evaluate the efficacy of future treatment modalities.

UNIT-I

General understanding of the terms – Histology, histopathology and histopathological techniques.

Organization of histopathological laboratory: Basic requirements of histopathology laboratory. (Glass wares, chemical and Reagent, Equipment and Instruments). Responsibilities of a histotechnologist.

UNIT-II

General introduction to processing of tissues. cell nucleus, cyto Membranes, cytoplasm, cell division).

Basic steps in tissue processing fixation, embedding, microtomy, staining, mounting.

Fixation and fixatives - Aim of fixation, classification of fixation, classification of fixatives, Different fixatives used, its advantages and disadvantages.

Decalcification - Aim of decalcification, selection of tissue, fixation, decalcifying agents used, Decalcification techniques.

Tissue processing- Technique of dehydration, clearing (Aim of cleaning, different cleaning agents), Impregnation, techniques of casting Blocking, section cutting.

Principles, operation, parts and use of automatic tissue processors.

UNIT-III

Microtomes-Different types of microtomes, microtone knives.

Staining- Principles of staining Basic staining techniques, special stains in histopathological studies.

Mounting- Different mounting media and mounting techniques.

UNIT-IV

Museum techniques- General introduction, organization of museum, mounting of museum specimens.

Frozen sections- Principles, methods used, freezing micro sections, staining of frozen sections and application of frozen sections.

Immunohistochemistry

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
2	Medical Laboratory Science – Theory and Practice	J. Ochei & A Kolhatkar	Mcgraw Hill
3	Hand book of Medical Laboratory Technology (2nd Ed)	V.H. Talib	CBS Publishers & Distributors
4	Medical Laboratory Technology Methods & Interpretation (5th Ed)	Ramnik Sood	Jaypee Brothers Medical publishers
5.	Medical laboratory Technology Volume-I	KL Mukherjee	Tata Mcgraw Hill
6.	Essentials of clinical Pathology	K Shirish	Jaypee Brothers

Clinical Biochemistry Lab

Course Code	**MLS 204**
Course Title	Clinical Biochemistry Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT – III Sem
Course Objective (CO)	To impart hands on training on sample collection, preservation and operational procedures of routine biochemical tests performed in clinical laboratory

List of experiment

1. Sample collection & specimen labeling of clinical samples
2. Interpretation and quoting of results of following routine tests performed in clinical biochemistry laboratory:
   Estimation of Serum
   a) Total proteins – albumins and globulins
   b) Creatinine
   c) Bilirubin
   d) HDL and LDL
   e) Total porphyrins
   f) Coproporphyrin
   g) Calcium
   h) Phosphorus
   i) Electolytes – Sodium, Potassium and chloride
3. Determination of Glucose tolerance test.
4. Urine analysis – normal & abnormal constituents of urine
5. CSF analysis – physical and chemical examination.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Hematology-III Lab

Course Code	**MLS208**
Course Title	Hematology-III Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –III Sem
Course Objective (CO)	This subject aims to enable the students to carry out routine clinical laboratory investigation (blood, urine etc). He/she should be able to provide technical help for sophisticated hematological techniques with adequate knowledge of various principles.

List of Experiments

1. Blood collection & preservation using different anticoagulants & preservative solutions
2. Component preparation
3. ABO grouping
4. Rh typing
5. Preparation of bone marrow smear for microscopic examination
6. Processing and staining of smear using Romanowsky stains
7. Investigation of blood from SLE patient for presence of LE cells.
8. Special hematological tests

    a) Sickling test
    b) Osmotic fragility
    c) Hemoglobin electrophoresis
    d) Determination of Foetal hemoglobin
    e) Demonstration of LE cells
    f) Test for Glucose-6-Phosphate dehydrogenase deficiency

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Pathology –III Lab

Course Code	**MLS212**
Course Title	Pathology -III Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –III Sem
Course Objective (CO)	The practical is aimed to make the students competent to isolate and identify fungi and viruses and do serological tests for various microbial infections.

List of experiments:

1. To perform the cultivation and identification of fungi on Sabouraud's dextrose agar.
2. To perform the cultivation and identification of fungi on cornmeal agar
3. To perform the cultivation of fungi on rich starch agar.
4. To perform the tease mount of mycelial filaments in Lactophenol cotton blue stain.
5. To perform the isolation and identification of fungi from soil sample.
6. To perform the isolation and identification of fungi from skin sample.
7. To perform the isolation and identification of fungi from nail sample.
8. To perform the India ink preparation of the yeast cells.
9. To perform the sensitivity testing of the fungal specimen.
10. To Demonstrate various inoculation routes in fertilized hen egg

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Concepts in Immunology and Immunological Techniques Lab

Course Code	MLS216
Course Title	Concepts in Immunology & Immunological Techniques Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –III Sem
Course Objective (CO)	The students will be able to understand the fundamentals of immunological reactions and their applications in the diagnosis of human diseases

List of Experiments:

1. Separation of serum and plasma from blood
2. Immunization of animal and Isolation of stimulated spleen cells
3. Performance of Serological tests *i.e.*
   Widal
   Brucella Tube Agglutination
   VDRL (including Antigen Preparation)
   ASO (Antistreptolysin 'O')
   C-Reactive Protein (Latex agglutination)
   Rheumatoid factor (RF) Latex agglutination
   Rose Waaler test,

4. Demonstration of antigen / antibody determination by Immunoflourescence, Immunodiffusions:
   Precipitation in agarose gel (ouchterlony)
   CCIEP
   RIA
   ELISA
   Immunoelectophoresis and Western blotting

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos.

Histopathology and Histopathological techniques Lab

Course Code	**MLS220**
Course Title	Histopathology and Histopathological techniques Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –III Sem
Course Objective (CO)	This part of the subject is aimed at exposing the students to the latest advancements and automation in the field of histopathology.

List of Experiments

1. Basic steps of tissue processing

    a) Preparation of fixatives and fixation.
    b) Embedding.
    c) Microtomy.
    d) Staining.
    e) Mounting

2. Various methods of preparation of tissue sections.
   Paraffin section, celloidin embedding, frozen section

3. Decalcification.

4. Tissue processing (Manual / Automatic).

5. Section cutting and sharpening of microtone knife.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Fifth Semester

Clinical Biochemistry – II

Course Code	MLS301
Course Title	Clinical Biochemistry – II
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc MLS / B.Sc MLT –II
Course Objective (CO)	The students will learn the advanced principles and procedures of clinical biochemistry for diagnosis and monitoring of human disease and their applications to biomedical research.

UNIT-I

Liver function tests: role of the liver in metabolism, formation of bilirubin and mode of excretion. Tests accessing the excretory and synthetic and metabolic function of liver, tests for clearance of exogenous substances from liver

Gastric analysis: composition of gastric juice, concepts of free and combined acids, gastric acid secretion stimulations. Methods of gastric analysis – collection of sample, titration and interpretation of results, Stimulation tests, Hollander`s test, tubeless gastric analysis, congo red test during oesophagogastroduodenoscopy

UNIT-II

Renal function tests: factors affecting renal function, renal function test – test for GFR, inulin clearance, creatinine clearance, urea clearance, clearance of radiolabelled agents.

Renal Calculi: theory of formation and analysis, renal clearance concentration and application of phenol sulfonaphthalein.

UNIT-III

Electrolyte metabolism: calcium metabolism, phosphate metabolism, sodium-potassium balance and trace element (Fe, Cu).

Metabolic disorders of proteins and amino acids, inborn errors of metabolic disorders

UNIT-IV

Diagnostic Enzyme assays: Clinical significances of enzyme assays, principle, procedures, normal values and clinical significances of SGOT, SGPT, phosphatases (acid & alkaline), LDH isozymes, Creatinine phosphokinase in liver diseases, myocardial infarctions, muscle and bone diseases and malignancies

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher

2	Medical laboratory Technology Volume-III (2nd Ed.)	KL Mukherjee	Tata Mcgraw Hill
3	Practical Clinical Biochemistry	Harold Varley	CBS Publishers & Distributers
4	Text book of Medical Biochemistry	M N Chaterjee and R. Shinde	Jaypee Brothers Medical Publishers(P) Ltd.
5.	Medical Laboratory Sciences, Theory & Practical	Arundhati Kolhatkar & J. ochei	Mcgraw Hill
6.	Basic Medical Laboratory Techniques	Barbara H. Estridge & Anna P. Reynolds	Delmer publishers

Pathology-IV (Cellular and Systemic Pathology)

Course Code	MLS305
Course Title	Pathology-IV (Cellular and Systemic Pathology)
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc MLS / B.Sc MLT –II
Course Objective (CO)	The students will obtain the basic knowledge of core aspects of pathology including, etiology, pathogenesis, morphological changes and functional derangements as well as various causes and consequences of diseases.

UNIT-I

Cell injury and adaptations: Normal Cell, types of cell injury, morphology and etiology of cell injury, cellular swelling

Types of cell death: autolysis, necrosis, apoptosis and gangrene

Cellular adaptations: atrophy, hypertrophy, hyperplasia and dysplasia

Inflammation: types - acute and chronic inflammation, events involved in inflammatory response.

UNIT-II

Haemodynamic disorders: Oedema, hyperemia, congestion, hemorrhage, circulatory disturbances, thrombosis, ischemia & infarction

Neoplasia: Definition, how does it differ from hyperplasia, difference between benign tumor and malignant tumor

Healing: Definition, different phases of healing, factors influencing wound healing

UNIT-III

Cellular and systemic Pathology: Study of diseases of various body organs and systems

Alimentary Canal: diseases of mouth, disease of oesophagus; oesophageal varices, gastritis, peptic ulceration, appendicitis, microbial disease, food poisoning, hernia, intestinal obstructions and malabsorption

Disease associated with accessory digestive glands: mumps, hepatitis, liver failure, cirrhosis, pancreatitis, Gall stones and jaundice

Cardiovascular diseases: diseases of blood- Atheroma, Arteriosclerosis, heart block. Disorders of Blood Pressure-Hyper & Hypotension

Diseases of respiratory organs: Upper respiratory tract infection, Bronchi, Asthma, Pneumonia, Lung abscess, Tuberculosis, Lung Collapse

Diseases of urinary system: Glomerulonephritis, Nephrotic syndrome, Renal failure, Renalcalculi, Urinary obstruction, Urinary tract infection.

UNIT-IV

Reproductive disorders: Sexually transmitted diseases, Pelvic inflammatory disease, disorder of cervix (CIN), Disease of ovaries, ectopic pregnancy, prostatitis, Infertility

Neural disorders: Neuronal damage, ICP, Cerebral Infarction, head injury, Alzheimer's disease, dementia.

Endocrine disorders: Pituitary: Hyper & Hypo secretions of pituitary, Goiter, Adrenal Cushing Syndrome, Addison Disease, Pancreatic diabetes

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Laboratory Technology (Methods and interpretation) 4th Ed	Ramneek Sood	J.P. Bros, New Delhi
2	Short text book of Medical Laboratory for technicians	Satish Gupta	J.P. Bros, New Delhi
3	Clinical Pathology and Bacteriology 8th Ed	Sachdev K.N	J.P. Bros, New Delhi
4	Text book of Pathology	Krishna	Orient Longman PVT Ltd.New Delhi
5.	Basic Pathology, 9th edition	Kumar, Abbas & Aster. Robbins.	Saunders

Blood Banking and Transfusion reactions

Course Code	MLS309
Course Title	Blood Banking and Transfusion reactions
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc MLS / B.Sc MLT –II
Course Objective (CO)	Blood transfusion has become a life saving procedure in modern medical sciences. To avoid any mistake, the students must understand to learn the blood bank procedures, such as ABO & Rh blood grouping carefully, accurately and long-term preservation for safe blood transfusion.

UNIT-I

Principle & Practices of Blood Transfusion: Principle & Practice of blood Transfusion, Blood Transfusion service at District level, Guide lines for the use of Blood, Appropriate use of Blood, Quality Assurance: Antilogous Blood Transfusion practices, Objectives of Quality Assurance in Blood Transfusion services, Standard operating procedures for usage, donation & storage of blood, screening of donor, compatibility testing, safety, procurement of supplies.

Blood donation: Introduction**,** Blood donor requirements, Criteria for selection & rejection**,** Medical history & personal details**,** Self-exclusion. Health checks before donating blood, Screening for TTI.

UNIT-II

Blood Collection: Blood collection packs, Anticoagulants, Taking & giving sets in Blood transfusion, Techniques of collecting blood from a doctor, Instructions given to the donor after blood donation, Adverse donor reaction.

Storage & Transport: Storage of blood, Changes in blood after storage, Gas refrigerator, Lay out of a blood bank refrigerator**,** Transportation.

UNIT-III

Blood banking: Testing Donor Blood- Screening donor's blood for infectious agents - HIV, HCV, HBV, palladium, Plasmodium, HTLV.Bacterially contaminated Blood.

Maintenance of Records:

Blood Donor Records: Blood donation record book, recording of results, Blood donor card.
Blood Bank Records: Blood bank temperature sheet, Blood bank stock sheet, Blood transfusion request form.

Compatibility Testing: Purpose**,** Single tube compatibility techniques using AHG reagent, Emergency compatibility testing, Difficulties in cross matching. Labeling & Issuing cross- matched blood.

UNIT-IV

Blood Components: Collection of blood components for fractional transfusion, Platelets packed Red Cell, Platelet rich Plasma, Platelets concentrate, Preparation of concentrated (packed) Red cells, Techniques of preparation.

Blood Transfusion Reactions: Investigation of a Transfusion reaction, Hemolytic transfusion reaction, Actions to take when transfusion reaction occurs.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
2	Medical laboratory Technology Volume-III (2nd Ed.)	KL Mukherjee	Tata Mcgraw Hill
3.	Medical Laboratory Sciences, Theory & Practical	Arundhati Kolhatkar & J. ochei	Mcgraw Hill
4.	Basic Medical Laboratory Techniques	Barbara H. Estridge & Anna P. Reynolds	Delmer publishers

Health systems and Laboratory Ethics

Course Code	MLS313
Course Title	Health systems and Laboratory Ethics
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc MLS / B.Sc MLT-II
Course Objective (CO)	The course has been designed to provide students knowledge about organization of health services, programmes, principle ethics, good laboratory practices, patient and laboratory management including office, financial and biomedical waste management.

UNIT-I

Introduction: Definition of Health, Determinants of Health, Health Indicators of India, National Health Policy

Organization of Health services: Brief description of organization of health services at the Centre and state levels

National Health Programmes: Family Welfare Programme, National Programme for water supply and sanitation, Nutritional Programmes, Immunization and universal immunization programme (Objectives and scope)
Disease Eradication programme: Leprosy & Guniea worm.
Disease control programmes: Tuberculosis, Malaria, Filaria, S.T.D, Goitre, Cholera and other diarrhaeal diseases and Natioanl Programme for prevention of blindness including trachoma.

UNIT-II

Ethical Principles and standards for a clinical laboratory professional: Duty to the patient**,** Duty to colleagues and other professionals**,** Duty to the society.

Good Laboratory Practice (GLP) Regulations and Accreditation
Introduction to Basics of GLP and Accreditation
Aims of GLP and Accreditation
Advantages of Accreditation
Brief knowledge about Nation and International Agencies for clinical laboratory accreditation

Awareness / Safety in a clinical laboratory
General safety precautions
HIV: pre- and Post-exposure guidelines
Hepatitis B & C: pre & Post-exposure guidelines
Drug Resistant Tuberculosis

Patient management for clinical samples collection: collection of sample, transportation and preservation
Sample accountability: Purpose of accountability, Methods of accountability
Sample analysis: Introduction, Factors affecting sample analysis

Reporting results: Basic format of a test report**,** Reported reference range**,** Clinical Alerts**,** Abnormal results**,** Turnaround time, Results from referral laboratories**,** Release of examination results**,** Alteration in reports

UNIT-III

Biomedical waste management in a clinical laboratory

Introduction and importance of calibration and Validation of Clinical Laboratory instruments

Laboratory Information system and financial Management: Introduction**,** Functions of a laboratory management system**,** Standards for laboratory management system**,** Introduction and awareness of financial management in a clinical**,** laboratory

UNIT-IV

Ethics in Medical laboratory Practice: Understanding the term 'Ethics'**,** Ethics in relation to the following:
Pre-Examination procedures
Examination procedures
Reporting of results
Preserving medical records
Access to Medical laboratory Records

Audit in a Medical Laboratory: Introduction and Importance**,** Responsibility**,** Planning Horizontal, Vertical and Test audit**,** Frequency of audit**,** Documentation

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Medical Laboratory Management	Sangeeta Sharma	Viva Books Pvt Ltd.
2	Clinical laboratory Management	Lynne Shore Garcia	

Histotechnology and Cytology

Course Code	MLS317
Course Title	Histotechnology and cytology
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc MLS / B.Sc MLT-II
Course Objective (CO)	This part of the subject is aimed at introducing the students to the various types of tissue preparations and developing expertise in the students to cut very thin tissue sections from tissue blocks and facilitate visualization using various stains and dyes. Cytology part aims at exposing the students to the latest advancements in cytological investigations.

UNIT-I

Introduction to Cytology: Basic terminology, Laboratory equipment for cytology, Normal cell structure, functions, cytologic criteria of malignancy, Types of specimens, methods of collection & preparation of cell block, Different fixatives and methods of fixation.

UNIT-II

Staining Techniques: Special Staining Procedures for detection of

a) Connective tissue elements, Trichrome staining, muscle fibers, elastic, reticulin fibres,collagen fibres etc.
b) Metachromatic staining such as toludine blue on frozen sections
c) Principles of metal impregnation techniques.
d) Demonstration and identification of minerals and pigments, removal of pigments/artifacts in tissue sections
e) Demonstration of Proteins & nucleic acids.
f) Demonstration of Carbohydrates, lipids, fat & fat like substances.
g) Demonstration of bacteria and fungi in tissue section.
h) Tissue requiring special treatment i.e. eye ball, bone marrow, muscle biopsy, undercalcified or uncalcified bones, whole brain, whole lungs including other large organs.

UNIT-III

Laboratory Techniques in Diagnostic Exfoliative Cytology: Preparation of specimens for cytological evaluation, Cytological stains and staining techniques, PAP staining and identification of cells in a normal vaginal smear, Characteristics of benign and malignant cells.

UNIT-IV

Fine Needle Aspiration Cytology (FNAC)

Automation in Cytology: Principles, equipments, procedures & evaluation of flow cytometry, Image analysis.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Medical Laboratory Technology	Paraful B. Godkar, Darshan P. Godkar	Bhalani Publisher
2	Medical Laboratory Science – Theory and Practice	J. Ochei & A Kolhatkar	Mcgraw Hill
3	Hand book of Medical Laboratory Technology (2nd Ed)	V.H. Talib	CBS Publishers & Distributors
4	Medical Laboratory Technology Methods & Interpretation (5th Ed)	Ramnik Sood	Jaypee Brothers Medical publishers
5.	Medical laboratory Technology Volume-I	KL Mukherjee	Tata Mcgraw Hill
6.	Essentials of clinical Pathology	K Shirish	Jaypee Brothers

Generic Skills and Entrepreneurship Development

Course Code	COM317
Course Title	Generic Skills And Entrepreneurship Development
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	
Course Objective (CO)	This paper is aimed at developing employability skills and conceptual understanding among students for setting up one's own business venture/enterprise

UNIT-I

Introduction to Generic Skills -Importance of Generic Skill Development (GSD), Global and Local Scenario of GSD, Life Long Learning (LLL) and associated importance of GSD.

Leadership Skills: Managing in Team - Team definition, hierarchy, team dynamics, Team related skills-sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group -conversation and listening skills

UNIT-II

Task Management - Task Initiation, Task Planning, Task execution, Task close out, Exercises/case studies on task planning towards development of skills for task management
Problem Solving - requisites of problem solving-meaningful learning, ability to apply
Knowledge in problem solving, different approaches for problem solving. Steps followed in problem solving, Exercises/case studies on problem solving.

UNIT-III

Entrepreneurship: Introduction, Concept/Meaning and its need, Competencies/qualities of an entrepreneur, Entrepreneurial Support System e.g., District Industry Centers
(DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC)
and other relevant institutions/organizations at State/National level.

UNIT- IV

Market Survey and Opportunity Identification (Business Planning)

- How to start a small scale industry
- Procedures for registration of small-scale industry
- List of items reserved for exclusive manufacture in small
-scale industry
- Understanding business opportunity

Clinical Biochemistry-II Lab

Course Code	MLS303
Course Title	Clinical Biochemistry-II Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –II
Course Objective (CO)	To impart skills to perform complex clinical procedures pertaining to diagnosis of human diseases. The students will also learn to perform all clinical tests on autoanalyzers.

List of experiments:

1. Specimen collections: urine, blood, gastric juice.
2. Accuracy, precision and quality control: demonstration and preparation of two methods using histogram, F-test and Barr test.
3. Estimation of bilirubin – total and conjugates, urobilinogens
4. Determination of free and total acidity
5. Clearance tests: Urea claearance and creatinine clearance
6. Analysis of renal calculi
7. Screening for inborn errors of metabolism.
8. Determination of clinically significant enzymes: principle, procedure and clinical significance of
    a) Serum alkaline phosphatases
    b) SGOT
    c) SGPT
    d) Creatine phosphokinaseLactate dehydrogenase
9. Demonstration on auto analyzer.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Pathology – IV Lab

Course Code	MLS307
Course Title	Pathology-IV Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –II
Course Objective (CO)	The students will learn to differences between the normal and pathological specimens by critically analyzing the morphological changes and functional derangements.

List of Experiments:

1. Study of following pathological conditions
    - Necrosis and apoptosis
    - Inflammation
    - Foot and hand gangrene
2. Study of diseases of following systems through permanent slides and charts:

    a) Cardio Vascular System:
    - Atheroma-aorta
    - Atherosclerosis
    - Myocardial Infarction
    - Rheumatoid Heart Disease (Rheumatic endocarditis, Rheumatic pericarditis)

    b) Respiratory System:
    - Lung abscess
    - TB Lung

    c) Renal System
    - Carcinoma- kidney

    d) Digestive System:

    GIT: (oesophageal varices, Gastric ulcer, Adenocarcinoma-Colon, TB, Liver abscess)
    - Acute appendicitis
    - Fatty Liver
    - Gall stones

    e) Reproductive system & Breast
    - Carcinoma breast
    - Carcinoma of cervix

    f) Lymph nodes

    g) Endocrine System

    h) Musculoskelatal System
    - Osteosarcoma.
    - Osteoclastoma

    i) CNS & PNS
    - Meningitis (TB meningitis, viral meningitis, Pyogenic meningitis)

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Blood Banking and Transfusion Reactions Lab

Course Code	**MLS311**
Course Title	Blood Banking and Transfusion Reactions Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT –II
Course Objective (CO)	Students will be able to understand the principles and practices including documentation and maintenance of records related to blood banking carefully and accurately.

List of Experiments:

1. Blood collection & preservation using different anticoagulants& preservative solutions
2. Component preparation
3. ABO grouping
4. Rh typing
5. Antibody direction & titration
6. Coombs test
7. Compatibility testing & cross matches
8. Investigation of transfusion reactions
9. Investigation of hemolytic disease of new born
10. HBsAg & HIV antibody testing in blood bank

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Health systems and Laboratory Ethics Lab

Course Code	**MLS315**
Course Title	Health Systems and Laboratory Ethics Lab
Type of course	Practical
L T P	0 0 2
Credits	1
Course prerequisite	B.Sc MLS / B.Sc MLT – II
Course Objective (CO)	Students will able to learn how to specimen collection and study principle ethics, good laboratory practices, patient and laboratory management including office, financial and biomedical waste management.

List of Experiments:

1. Clinical sample collection: Blood, Urine, Stool, Saliva sample, Sputum sample and Semen etc.
2. Sample accountability: Labeling of sample, Making entries in Laboratory records
3. Reporting results: Basic format of a test report, Release of examination results, Alteration in reports
4. Quality Management system: Internal and External quality control
5. Biomedical waste management in a clinical laboratory: Disposal of used samples, reagents and other biomedical waste
6. Calibration and Validation of Clinical Laboratory instruments
7. Ethics in Medical laboratory Practice in relation to the following:

a) Pre-Examination procedures
b) Examination procedures
c) Reporting of results
d) Preserving medical records
e) Access to Medical laboratory Records

8. Audit in a Medical Laboratory: Documentation

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Histotechnology and Cytology Lab

Course Code	**MLS319**
Course Title	Histotechnology and cytology Lab
Type of course	Practical
L T P	0 0 3
Credits	1.5
Course prerequisite	B.Sc MLS / B.Sc MLT – II
Course Objective (CO)	This part of the subject is aimed at exposing the students to the latest advancements and automation in the field of histopathology and cytology

List of Experiments:

1. Collection of samples and processing.
2. Cytological fixatives and fixation.
3. Special Staining Procedures for detection of
    a) Connective tissue elements, Trichrome staining, muscle fibers, elastic, reticulin fibres,collagen fibres etc.
    b) Metachromatic staining such as toludine blue on frozen sections
    c) Principles of metal impregnation techniques.
    d) Demonstration and identification of minerals and pigments, removal of pigments/artifacts in tissue sections
    e) Demonstration of Proteins & nucleic acids.
    f) Demonstration of Carbohydrates, lipids, fat & fat like substances.
    g) Demonstration of bacteria and fungi in tissue section.
    h) Tissue requiring special treatment i.e. eye ball, bone marrow, muscle biopsy, uncalcified bones, whole brain, whole lungs including other large organs.
4. Collection and preparation of fluid sediment for cytological examination.
5. Preparation and fixation of sputum smears for cytology and preparation.
6. Preparation and fixation of vaginal and cervical smears for cytology.
7. Hormonal evaluation of vaginal smears.
8. Papaniculaou staining-principles and staining procedures.
9. Identification of cells.
10. Differentiation between malignant and benign cells.

Note: Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos

Sixth Semester

Professional Training

Course Code	**MLS302**
Course Title	Professional Training
Type of course	Practical
L T P	0 0 25
Credits	25
Course prerequisite	B.Sc MLS / B.Sc MLT – II
Course Objective (CO)	The students will undergo 3 months training to learn about latest diagnostic techniques used in laboratories

Guideline To Carry Out Training

1. **Purpose of training:** The main purpose of training is to make the students familiar with the latest techniques used in the diagnosis. This will not only help train the inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career.

2. Duration of training :- Recommended duration of training is 05 months which includes 3 months of training and 2 months for report compilation. The students should undergo training in a reputed hospital with well established laboratories.

3. Submission of training report:-

a. After completion of training each student should prepare a PowerPoint presentation to be delivered to the respective department committee.

b. The committee should conduct comprehensive viva-voce of the students.

c. The final copy of the report (2 Copies) will have to be submitted to the respective CODs.