

Punjab Technical University
B.Sc. Medical Laboratory Sciences

First Semester

Course Code.	Course Name	L	T	P	Marks		Total	Cr.
					Int.	Ext.		
BMLS-101	Essential Biology	3	-	-	40	60	100	3
BMLS-102	General Microbiology	4	-	-	40	60	100	4
BMLS-103	Basic Haematology & Haematological	4	-	-	40	60	100	4
BMLS-104	Human Anatomy & Physiology-I	4	-	-	40	60	100	4
BMLS-105	Basics of Biochemistry	4	-	-	40	60	100	4
BMLS-106	Essential Biology – Practical	-	-	3	40	60	100	2
BMLS-107	General Microbiology – Practical	-	-	5	40	60	100	3
BMLS-108	Basic Haematology & Haematological	-	-	4	40	60	100	2
BMLS-109	Human Anatomy & Physiology-1-	-	-	3	40	60	100	2
BMLS-110	Basics of Biochemistry – Practical	-	-	3	40	60	100	2
Guest Lecture/ Tutorial/ Seminar/visit to any medical research institution or reputed clinical laboratory (Compulsory)		-	2	-				
Total					400	600	1000	30

Second Semester

Course Code.	Course Name	L	T	P	Marks		Total	Cr.
					Int.	Ext.		
HVPE-101	Human Values and Professional Ethics	3	-	-	40	60	100	3
BMLS-202	Systematic Bacteriology	4	-	-	40	60	100	4
BMLS-203	Basic Haematology Techniques –II	4	-	-	40	60	100	4
	Human Anatomy & Physiology –II	4	-	-	40	60	100	4
BMLS-205	Biochemical Metabolism	4	-	-	40	60	100	4
HVPE-102	Human Values and Professional Ethics – Practical	-	-	3	40	60	100	2
BMLS-207	Systematic Bacteriology- Practical	-	-	5	40	60	100	3
BMLS-208	Basic Haematology Techniques – II Practical	-	-	4	40	60	100	2
BMLS-209	Human Anatomy & Physiology –II –	-	-	3	40	60	100	2
BMLS-210	Biochemical Metabolism – Practical	-	-	3	40	60	100	2
Guest Lecture/ Tutorial/ Seminar/visit to any medical research institution or reputed clinical laboratory (Compulsory)		-	2	-				
Total					400	600	1000	30

Third Semester

Course Code.	Course Name	L	T	P	Marks		Total	Cr. hr
					Int.	Ext		
BMLS-301	Communication Skills	3	-	-	40	60	100	3
BMLS-302	Applied Bacteriology	4	-	-	40	60	100	4
BMLS-303	Applied Haematology-I	4	-	-	40	60	100	4
BMLS-304	Basic Cellular Pathology	4	-	-	40	60	100	4
BMLS-305	Analytical Biochemistry	4	-	-	40	60	100	4
BMLS-306	Communication Skills - Practical	-	-	3	40	60	100	2
BMLS-307	Applied Bacteriology - Practical	-	-	5	40	60	100	3
BMLS-308	Applied Haematology-I - Practical	-	-	4	40	60	100	2
BMLS-309	Basic Cellular Pathology – Practical	-	-	3	40	60	100	2
BMLS-310	Analytical Biochemistry –	-	-	3	40	60	100	2
Guest Lecture/ Tutorial/ Seminar/visit to any medical research institution or reputed clinical laboratory (Compulsory)		-	2	-				
Total					400	600	1000	30

Fourth Semester

Course No.	Course Name	L	T	P	Marks		Total	Cr. Hr
					Int.	Ext		
BMLS-401	Fundamentals of Computers	2	-	-	40	60	100	2
BMLS-402	Immunology & Mycology	4	-	-	40	60	100	4
BMLS-403	Applied Haematology-II	4	-	-	40	60	100	4
BMLS-404	Histotechnology-I	4	-	-	40	60	100	4
BMLS-405	Clinical Biochemistry-I	4	-	-	40	60	100	4
BMLS-406	Fundamentals of Computers – Practical	-	-	3	40	60	100	2
BMLS-407	Immunology & Mycology –	-	-	5	40	60	100	3
BMLS-408	Applied Haematology-II – Practical	-	-	4	40	60	100	2
BMLS-409	Histotechnology-I - Practical	-	-	3	40	60	100	2
BMLS-410	Clinical Biochemistry-I - Practical	-	-	3	40	60	100	2
Guest Lecture/ Tutorial/ Seminar/visit to any medical research institution or reputed clinical laboratory (Compulsory)		-	2	-				
Total					400	600	1000	29

Fifth Semester

Course No.	Course Name	L	T	P	Marks		Total	Cr. Hr
					Int.	Ext		
BMLS-501	Medical Laboratory Management	3	-	-	40	60	100	3
BMLS-502	Parasitology & Virology	4	-	-	40	60	100	4
BMLS-503	Blood Banking	4	-	-	40	60	100	4
BMLS-504	Histotechnology-II & Cytology	4	-	-	40	60	100	4
BMLS-505	Clinical Biochemistry-II	4	-	-	40	60	100	4
BMLS-506	Medical Laboratory Management - Practical	-	-	3	40	60	100	2
BMLS-507	Parasitology & Virology - Practical	-	-	5	40	60	100	3
BMLS-508	Blood Banking - Practical	-	-	4	40	60	100	2
BMLS-509	Histotechnology-II & Cytology – Practical	-	-	3	40	60	100	2
BMLS-510	Clinical Biochemistry-II –	-	-	3	40	60	100	2
Guest Lecture/ Tutorial/ Seminar/visit to any medical research institution or reputed clinical laboratory (Compulsory)		-	2	-				
Total					400	600	1000	30

Sixth Semester

Course No.	Course Name	L	T	P	Marks		Total	Cr. Hr
					Int.	Ext.		
BMLS-601	Environmental Sciences	4	1	-	40	60	100	5
BMLS-602	Professional Training (Three Months)	Three Months -			0	200	200	25
BMLS-603	Environmental Sciences - Practical	2			40	60	100	2
BMLS-604	Internal assessment				100	0	100	
	Project/Practical file				0	200	200	
	Practical (Performance) and viva				0	300	300	
	Total Marks					180	820	1000

For evaluation of Professional Training, out of 700 marks, 200 will be awarded by the healthcare industry where the candidate has taken training. After taking 3 months training from healthcare industry the candidate shall report back to parent institute where he/she will submit his/her project report and will attend the institute for rest of the semester period. Then at the end of the semester he/she will appear for the Practical examinations in the presence of Internal & external Examiners. Out of rest 500 marks 200 will be for Project/Practical file and 300 for Practical and *Viva voce* (by external examiner)

**B.Sc Medical Laboratory Science
(B.Sc MLS)**

First Semester

ESSENTIAL BIOLOGY BMLS-101

UNIT-I

Introduction

Biology & Its Branches; Scientific methods in Biology; Scope of biology and career options in Medical Laboratory Sciences; Characters of living organisms (elementary idea of metabolism, transfer of energy at molecular level, open and closed systems, homeostasis, growth and reproduction, adaptation, survival, death). Origin and Evolution of life - Theories of Evolution; Evidence of Evolution; Sources of Variations (mutation, recombination, genetic drift, migration, natural selection); Concept of species; Speciation and Isolation (geographical and reproductive); Origin of species.

UNIT-II

Ecology and Environment

Atmosphere; Hydrosphere; Lithosphere; Abiotic and Biotic components of Ecosystem; Biogeochemical cycles of Carbon, Nitrogen and Oxygen; Food Chain and Food web.

Diversity of Life

Diversity of living organisms, Systematics; Need, history and types of classification (artificial, natural, polygenetic); biosystematics; binomial nomenclature; Two kingdom system, Five kingdom System, their merits and demerits, status of bacteria and virus; Morphology of animals - salient features of pathogenic microbes, protozoan, helminthes and insects structure and function of tissues - epithelial, connective, muscular and nervous.

UNIT-III

Cell and Cell Division

Cell as a basic unit of life - discovery of cell, cell theory, cell as a self - contained unit; prokaryotic and eukaryotic cell; unicellular and multicellular organisms; Ultrastructure of prokaryotic and eukaryotic cell - cell wall, cell membrane - unit membrane concept (Fluid-Mosaic model); membrane transport; cellular movement (exocytosis, endocytosis); cell organelles and their functions- nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microtubules, centriole, vacuole, cytoskeleton, cilia and flagella, ribosomes. Molecules of cell; inorganic and organic materials - water, salt, mineral ions, carbohydrates, lipids, amino acids, proteins, nucleotides, nucleic acids (DNA and RNA); Enzymes (Properties, chemical nature and mechanism of action); vitamins, hormones and steroids.

Unit IV

Genetics

Continuity of life - heredity, variation; Mendel's laws of inheritance, chromosomal basis of inheritance; other patterns of inheritance - incomplete dominance, multiple allelism, quantitative inheritance. Chromosomes - bacterial cell and eukaryotic cell; parallelism between genes and chromosomes; genome, linkage and crossing over; gene mapping; recombination; DNA as a genetic material - its structure and replication; structure of RNA and its role in protein synthesis

GENERAL MICROBIOLOGY**BMLS-102**

Aims /learning Objectives: This subject gives the general insight into history and basics of medical microbiology, imparts the knowledge about equipments used in Medical Microbiology and basic procedures done in medical microbiology laboratory i.e. microscopy, sterilization, disinfection, culture methods required to perform different microbiological tests in clinical microbiology lab. and biomedical waste management.

Unit-I**1. Introduction to Medical Microbiology:**

- Definition - History - Host-Microbe relationship.

2. Safety measures in clinical Microbiology**3. Glassware used in Clinical Microbiology Laboratory:**

- Introduction - Care and handling of glassware - Cleaning of glassware

4. Equipments used in clinical Microbiology Laboratory:

- Introduction - Care and maintenance

Unit-II**5. Microscopy**

- Introduction and history

- Types of microscopes

(a) Light microscope (b) DGI(c) Fluorescent (d) Phase contrast

(e) Electron microscope:

Transmission

Scanning

- Principles and operational mechanisms of various types of microscopes

6. Sterilization:

- Definition

- Types and principles of sterilization

methods (a) Heat (dry heat, moist heat with

special Reference to autoclave)

(b) Radiation (c) Filtration

- Efficiency testing to various sterilizers

7. Antiseptics and disinfectants:

- Definition.- Types and properties - Mode of action - Uses of various disinfectants

- Precautions while using the disinfectants - Qualities of a good disinfectant

- In-house preparation of alcoholic hand/skin disinfectants.

- Testing efficiency of various disinfectants

8. Biomedical waste management in a Microbiology laboratory:

- Types of the waste generated – Segregation – Treatment - Disposal

Unit-III**9. General characteristics & classification of Microbes : (Bacteria & fungi)**

- Classification of microbes with special reference to prokaryotes & eukaryotes

- Morphological classification of bacteria

- Bacterial anatomy (Bacterial cell structures)

10. Growth and Nutrition of Microbes :

- General nutritional & other requirements of the bacteria
- Classification of bacteria on the basis of their nutritional requirements
- Physical conditions required for growth.
- Normal growth cycle of bacteria (growth curve)
- Types of microbial cultures: Synchronous, Static, continuous culture.

Unit-IV

11. Culture media:

- Introduction
- Classification of culture media (with Examples & Uses) solid media, liquid media, semisolid, Media,, routine/synthetic/defined media, basal media, enriched , enrichment, Selective, differential media, sugar fermentation media, transport media, preservation media and anaerobic culture media.
- Quality control in culture media
- Automation in culture media preparation

12. Aerobic & anaerobic culture methods:

- Concepts
- Methods Used for aerobic cultures
- Methods used for anaerobic cultures.

13. Introductions to Immunology

- Immunity
- Antigens and Antibodies

14. Care & handling of laboratory animals:

- Introduction
- General care & handling
- Ethics & legality in use of laboratory animals

Suggested Readings:

1. Practical Medical Microbiology by Mackie and MacCartney
 2. Text book of Microbiology by Ananthanereyan
 3. Medical Microbiology by Paniker & Satish Gupte
 4. Medical laboratory Technology vol. I , II, III by Mukherjee
 5. District Laboratory Practice in tropical countries Vol II Microbiology by Monia Cheesbrough
 6. Text book of Microbiology by Prescott
 7. Practical Medical Microbiology by Mackie & MacCartney Volume 1 and 2
 8. Immunology by Kuby .
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**BASIC HAEMATOLOGY & HAEMATOLOGICAL
TECHNIQUES-I BMLS-103**

Aims /learning

Objectives:

The students will be made aware of the composition of blood and methods of estimating different components of blood. Students will be able to know the basic concepts of Haematology & routine clinical investigations of Haematology laboratory.

Unit-I

**1. Introduction to
Haematology**

(a) Definition (b) Importance (c) Important equipment used.

**2. Laboratory organization and safety measures in haematology
Laboratory**

**3. Introduction to blood, its composition, function and normal cellular
components.**

**4. Formation of cellular components of
blood.**

(a) Erythropoiesis (b) Leucopoiesis (c)
Thrombopoiesis

Unit-II

5. Collection and preservation of blood sample for various haematological investigations

6. Preparation of blood

Films

Types. Methods of preparation (Thick and thin smear/film)

Unit-III

**7. Definition, principles & procedure, Normal values, Clinical significance, errors
involved, means to minimize errors for the following**

1. Haemoglobinometry, PCV, Red Cell Indices
2. Total leucocytes count (TLC)
3. Differential leucocytes count (DLC), Eosinophil count, Reticulocyte count and Platelet Count.
4. Erythrocyte Sedimentation Rate (ESR)

Unit-IV

**8. Staining techniques in Haematology (Romanowsky's stains) : Principle, composition,
preparation of staining reagents and procedure of the following**

1. Giemsa stain
2. Leishman stain
3. Wright's stain
4. Field's stain
5. JSB stain.

Suggested

Readings:

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
 2. Medical laboratory Technology by KL Mukherjee Volume-I
 3. Haematology for students Practitioners by Ramnik Sood
 4. Hand book of Medical Laboratory Technology(IIInd edition) by V.H. Talib
 5. Haematology (International edition)Emmanuel C.Besa Harwal Publisher
 6. Practical Haematology by JB Dacie
 7. Practical Haematology(8th edition) by Sir John
 8. Clinical Haematology by Christopher A. Ludlam
 9. Clinical Diagnosis &Management by Laboratory methods(20th edition) by John
bernard Henary
 10. Medical Laboratory Technology Methods & Interpretation(5th edition) by Ramnik Sood
 11. Atlas of haematology(5th edition)by G.A. McDonald
 12. A Manual of Laboratory & Diagnostic Tests(6th edition)by Frances Fischbach
 13. Haematology (Pathophysiological basis for clinical practice) by Stephen M.
Robinson
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Suggested Readings:

HUMAN ANATOMY AND PHYSIOLOGY- I
BMLS-104

Aims /learning Objectives:

Students will be able to learn the terminology of the subject and basic knowledge of cells, tissues, blood and to understand anatomy and physiology of human body. This subject will develop an understanding of the structure and function of organs and organ systems in normal human body.

Unit-1

1. Introduction to human Anatomy and Physiology.

2. Cell and cell organelles.

- (a) Structure and classification (b) Function
- (c) Cell division (Mitosis and Meiosis)

3. Tissues

- (a) Definition (b) Classification with structure and Functions. (i) Epithelial tissues
- (ii) Connective tissues
- (iii) Muscular tissues
- (iv) Nervous tissue

Unit-2

4. Blood.

- (a) Composition and function of blood

5. Muscular skeletal system

- (a) Introduction (b) Classification
- (c) Structure and function of skeletal system, muscles and joints. (d) various movements of body.

Unit-3

6. Respiratory system

- (a) Introduction (b) Structure
- (c) Function (d) Mechanism of breathing and respiration
- (e) Various terms involved in respiratory System. (i) Vital capacity.
- (ii) Total Volume.
- (iii) Reserve volume. (iv) Total lung capacity.

7 Cardiovascular system.

- (a) Anatomy and physiology of heart
- (b) Blood circulation.
- (c) Arteries and veins.
- (d) Conductive system of heart.
- (e) Cardiac cycle.
- (f) Introduction to ECG.

Suggested Readings:

Unit-4

8. Lymphatic system.

- (a) Introduction.
- (b) Structure and function
 - (i) Lymph nodes.
 - (ii) Spleen.
 - (iii) Thymus gland, Tonsils

9. Structure and function of sense organs.

- (a) Eye. (b) Ear.
- (c) Nose. (d) Tongue.

Suggested Readings

1. Anatomy and Physiology- Ross and Wilson
 2. Anatomy and Physiology: Understanding the Human Body by Clark
 3. Anatomy and Physiology for nurses by Evelyn Pearce
 4. Anatomy and Physiology for nurses by Sears
 5. Anatomy and Physiology for nurses by Pearson
 6. Anatomy and Physiology by N Murgesh
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BASICS OF BIOCHEMISTRY**BMLS-105**

Aims /learning Objectives: The main objective of the subject is to impart the knowledge of apparatus, units, equipments, volumetric analysis in the laboratory of clinical Biochemistry.

Unit-I**1. Introduction to Medical lab Technology:**

(a) Role of Medical lab Technologist (b) Ethics, Responsibility (c) Safety measures (d) First aid.

2. Cleaning and care of general laboratory glass ware and equipments:

(a) Steps involved in cleaning soda lime glass (b) Steps involved in cleaning borosil glass (c) Preparation of chromic acid solution (d) Storage

Unit-II**3. Distilled water:**

(a) Method of preparation of distilled water (b) Types of water distillation plants (c) Storage of distilled water

4. Units of Measurement:

(a) S.I unit and CGS units (b) Conversion of units
(c) Strength, molecular weight, equivalent weight
(d) Normality, Molarity, Molality (e) Numericals.

Unit-III**5. Calibration of volumetric apparatus:**

(a) Flask (b) Pipettes
(c) Burettes (d) Cylinders.

6. Analytical Balance: (a) Principle (b) Working (c) Maintenance**7. Concept of pH:**

(a) Definition (b) Henderson Hasselbatch equation (c) Pka value (d) pH indicator (e) Methods of measurement of pH (i) pH paper (ii) pH meter (iii) Principle, working, maintenance and calibration of pH meter

Unit- IV**8. Volumetric analysis:**

(a) Normal and molar solutions (b) Standard solutions
(c) Preparation of reagents (d) Storage of chemicals

9. Osmosis:

(a) Definition
(b) Types of osmosis
(c) Factors affecting osmotic pressure (d) Vant Hoff's equation (e) Applications of osmosis
(f) Dialysis

Suggested Readings

1. Text book of Medical Laboratory Technology by P. B. Godker
2. Medical Laboratory Technology by KL Mukherjee volume III
3. Practical Clinical Biochemistry by Harold Varley
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chaterjee Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet & Voet
9. Biochemistry by Stryer

ESSENTIAL BIOLOGY- PRACTICAL

BMLS-106

1. Study of evolution through charts and models
 2. Study of Mitosis and Meiosis through animal cells (Grasshopper)
 3. Study of mitochondria and Nucleus by staining with a Janus Green and Methylene Blue respectively.
 4. Study of osmosis and diffusion
 5. Study of permanent slides of Pathogenic Protozoans like *Entamoeba*, *Plasmodium*, *Trypanosoma*, *Leishmania*, *Giardia*, and Pathogenic Helminthes like *Fasciola*, *Ancylostoma*, *Trichinella*, *Oxyuris*, *Wuchereria*
 6. Study of specimens of *Anopheles*, *Culex*, *Aedes*, *Stenocephalide*, *Pediculus*, *Musca* and their reasons for identification.
 7. Study of Epithelial, Muscle, Nerve and mammalian blood cells through permanent or temporary cells.
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GENERAL MICROBIOLOGY-PRACTICAL
BMLS-107

Aims /learning Objectives: Students are able to classify, identify, use of instruments, sterilization, cultural requirements and to perform different microbiological tests in clinical microbiology lab.

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 working & handling of Compound microscope.
4. To demonstrate the method of sterilization by autoclave.
5. To demonstrate the method of sterilization by hot air oven.
6. To demonstrate the method of sterilization of media/solution by filtration.
7. Demonstration of antiseptics, spirit, cetrimide & Povidone-Iodine .
8. To demonstrate the use of disinfectants.
9. Demonstrate the precaution while using disinfectants.
10. To prepare working dilution of commonly used disinfectants.
11. In-use test
12. Rideal-walker phenol co-efficient test.
13. To demonstrate the different morphological types of bacteria.
14. Preparation of one culture media from each type.
15. To demonstrate aerobic culture
16. To demonstrate anaerobic culture.
17. Visit to animal house & demonstrate about care of laboratory animals.

BASIC HAEMATOLOGY & HAEMATOLOGICAL TECHNIQUES-I PRACTICAL

BMLS-108

Aims /learning Objectives: Students will be able to know the basic concepts of Haematology & outline clinical investigations of Haematology lab.

1. Demonstration of Equipments used in clinical Haematology.
 - (a) Microscope
 - (b) Blood Cell counter (DLC)
 - (c) Sahli's apparatus
 - (d) Calorimeter
 2. Hb Estimation
 - (a) Sahli's method
 - (b) Cyanmethaemoglobin method
 - (c) Oxyhaemoglobin method
 3. Total leukocyte count
 4. Preparation of smear and staining with Giemsa and Leishman stain.
 5. Differential leucocytes count
 6. Platelets count
 7. Reticulocyte count
 8. Absolute Eosinophil count
 9. Calculation of Red cell indices (RCI)
 - 10 ESR (Wintrobe and Westergren method)
 - 11. Packed cell volume (Macro & Micro)**
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HUMAN ANATOMY AND PHYSIOLOGY-PRACTICAL

BMLS-109

Aims /learning Objectives: Students will be able to learn the terminology of the subject and basic knowledge of cells, tissues, blood and to understand anatomy and physiology of human body.

1. Demonstration of human cell from slides/charts.
 2. Demonstration of cell division i.e. mitosis and Meiosis from permanent mounted slides.
 3. Demonstration of various tissues from permanent slides.
 - (i) Epithelial tissue
 - (ii) Connective tissue.
 - (iii) Muscular tissue
 - (iv) Nervous tissue
 4. Demonstration of individual bone.
 5. Demonstration of respiratory system from chart.
 6. Pear expiratory flow rate(PEFR)
 7. Demonstration of cardiovascular system form chart.
 8. Electro cardio gram (ECG)
 9. Demonstration of eye, nose, ear and tongue from model and charts.
 10. To study and count spleenocytes from mammalian spleen
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BASICS OF BIOCHEMISTRY-PRACTICAL

BMLS-110

Aims /learning Objectives: The main objective of the subject is to impart the knowledge of apparatus, units, equipments, volumetric analysis in the laboratory of clinical biochemistry

1. Cleaning of the laboratory glass ware.
 2. Preparation of distilled water
 3. Principle, working and maintenance of pH meter.
 4. To prepare 0.1 N NaoH solution.
 5. To prepare 0.2N HCl solution.
 6. To prepare 0.1 molar H_2SO_4
 7. To prepare 0.2 Molar Sodium carbonate solution.
 8. Demonstration of osmosis and dialysis.
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B.Sc Medical Laboratory Science

(B.Sc MLS)

Second Semester

HUMAN VALUES AND PROFESSIONAL ETHICS**HVPE – 101****Objective/s and Expected outcome:**

To make the students learn to discriminate between valuable and superficial in the life. To help develop the critical ability to distinguish between essence and form, or between what is of value and what is superficial, in life - this ability is to be developed not for a narrow area or field of study, but for everyday situations in life, covering the widest possible canvas. To help students develop sensitivity and awareness; leading to commitment and courage to act on their own belief. It is not sufficient to develop the discrimination ability, it is important to act on such discrimination in a given situation. Knowingly or unknowingly, our education system has focused on the skill aspects (learning and doing) - it concentrates on providing to its students the skills to do things. In other words, it concentrates on providing "How to do" things. The aspects of understanding "What to do" or "Why something should be done" is assumed. No significant cogent material on understanding is included as a part of the curriculum. A result of this is the production of graduates who tend to join into a blind race for wealth, position and jobs. Often it leads to misuse of the skills; and confusion and wealth that breeds chaos in family, problems in society, and imbalance in nature. This course is an effort to fulfill our responsibility to provide our students this significant input about understanding. This course encourages students to discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life. It has been experimented at IITB, IITK and UPTU on a large scale with significant results.

Unit-I**1. Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

- Understanding the need, basic guidelines, content and process for Value Education.
- Self Exploration—what is it?- its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations

- Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfill the above human aspirations: understanding and living in **harmony** at various levels **(6 Hrs)**

Unit-II

2. Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure *Sanyam* and *Swasthya* **(6 Hrs)**

Unit-III

3. Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

- Understanding harmony in the Family- the basic unit of human interaction
- Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
- Understanding the meaning of *Vishwas*; Difference between intention and competence
- Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society (*Akhand*)

Samajj), Universal Order (*Sarvabhaum Vyawastha*)- from family to world family!

(6 Hrs.)

Unit-IV

4. Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence (4 Hrs)

5. Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:
 - Ability to utilize the professional competence for augmenting universal human order
 - Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems
 - Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:
 - At the level of individual: as socially and ecologically responsible engineers, technologists and managers
 - At the level of society: as mutually enriching institutions and organizations

(6 Hrs.)

Text Book:

1. R R Gaur, R Sangal, G P Bagaria, 2009, *A Foundation Course in Value Education*.

Other Suggested Readings / Books:

1. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
2. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
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Systematic Bacteriology

BMLS-202

THEORY

Aims and Objectives:

This subject will give information about the different types of bacterial culture procedures, staining procedures and Biochemical tests used for identification of bacteria. The students will learn the morphology cultural characteristics, biochemical characteristics & laboratory diagnosis of various bacteria.

Unit-I

1. Bacterial culture
 - a. Instruments used to seed culture media
 - b. Culture procedures - seeding a plate

2. Staining techniques in bacteriology
 - a) Significance of staining in bacteriology
 - b) Principle, procedures and interpretation of the following staining techniques.
 - Simple staining
 - Negative staining
 - Gram stain
 - Albert's stain
 - Neisser's stain
 - Ziehl –Neelsen staining
 - Capsule staining
 - Flagella staining
 - Spore staining
 - Fontana stain for spirochetes.

Unit-II

3. Principle, procedures and interpretation of the following biochemical tests for identification of different bacteria.

- a) Catalase
- b) Coagulase
- c) Indole
- d) Methyl Red
- e) Voges Proskauer
- f) Urease
- g) Citrate
- h) Oxidase
- i) TSIA
- j) Nitrate reduction
- k) Carbohydrate fermentation
- l) Huger and Leifson
- m) Bile solubility
- n) H₂S production
- o) Demonstration of motility
- p) Decarboxylases
- q) CAMP
- r) Hippurate hydrolysis
- s) Nagler's reaction

Unit-III

4. Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the following bacteria
- a) Staphylococcus
 - b) Streptococcus
 - c) Pneumococcus
 - d) Neisseria gonorrhoeae and Neisseria meningitidis
 - e) Haemophilis
 - f) Enterobacteriaceae: Escherichia coli, Klebsiella, Citrobacter, Enterobacter, Proteus, Salmonella, Shigella, Yersinia enterocolitica and Yersinia pestis

Unit-IV

- g) Corynebacterium

- h) Vibrio , Aeromonas and Plesiomonas
- i) Clostridium
- j) Mycobacterium tuberculosis complex, Atypical Mycobacteria and M. leprae
- k) Spirochetes – Treponema, Borrelia and leptospira
- l) Bordetella and brucella

- m) Mycoplasma and Ureaplasma
- n) Rickettsia
- o) Chlamydia
- p) Actinomyces
- q) Pseudomonas and Burkholderia
- r) Brief introduction about non sporing anaerobic cocci and bacilli.

Suggested Readings:

1. Practical Medical Microbiology by Mackie & MacCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanereyan
3. Medical Microbiology by Paniker & Satish Gupte
4. Medical laboratory Technology vol.I ,II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol II Microbiology by Monia Cheesbrough

BMLS –203

THEORY

Aims and Objectives:

The students will learn about normal and abnormal haemoglobin and different aspects of Normal haemostatic mechanism and theories of blood coagulation. They will also learn the estimation of different parameters of coagulation studies.

Unit-I

1. Haemoglobin pigments and their measurement.
2. Abnormal haemoglobins, their identification and estimation.

Unit-II

3. Normal haemostatic mechanism and theories of blood coagulation.
4. Classification of coagulation factors.
5. Physiological properties of various coagulation factors.

Unit-III

6. Preparation and standardization of various coagulation reagents such as Tissue Thromboplastin, Cephalin, Kaolin, Thrombin, M/40 CaCl₂.

Unit-IV

7. Screening coagulation tests such as Bleeding and clotting Time, Hess test, prothrombin time(PT) and Activated Partial Thromboplastin time (APTT)

Suggested readings

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Practical Haematology by JB Dacie

3. Hand book of Medical Laboratory Technology(IInd edition) by V.H. Talib
4. Haematology (International edition)Emmanuel C.Besa Harwal Publisher
5. Practical Haematology(8th edition) by Sir John
6. Clinical Haematology by Christopher A. Ludlam
7. Clinical Diagnosis &Management by Laboratory methods(20th edition) by John bernard Henary
8. Medical Laboratory Technology Methods &Interpretation(5th edition) by Ramnik Sood
9. Atlas of haematology(5th edition)by G.A. McDonald
10. A Manual of Laboratory & Diagnostic Tests(6th edition)by Frances Fischbach
11. Haematology(Pathophysiological basis for clinical practice(3rd edition)by Stephen M. Robinson .

BMLS – 204

THEORY

Aims and Objectives:

Students will be able to learn the terminology of the subject and basic knowledge of cells the structure and function of organs and organ systems and body fluids in normal human body.

Unit-1

1. Body fluids and their significance : Important terms , types of body fluid , total body water , avenues by which water leaves and enters body , general principles for fluid balance , cardinal principle , How body fluids maintain Homeostasis , Electrolytes & ions Function of electrolytes , How electrolyte imbalance leads to fluid imbalance

Unit-2

2. Digestive system: Organisation ; accessory organs ; structure & function (Mouth, Tongue, Teeth, Oesophagus , Pharynx, Stomach, Intestine, Rectum, Anus); Digestive glands; physiology of digestion of carbohydrates ,lipids & proteins
3. Liver: structure and function

Unit-3

4. Urinary system: Main parts , Structure & function of kidney , structure of nephron, physiology of excretion & urine formation , urine , additional excretory organs
5. Genital system: Structure of male and female reproductive system, Gametogenesis in male & female, menstrual cycle. Placenta and extra embryonic membranes.

Unit-4

6. Nervous system: Parts, function & structure ; brain , spinal cord , spinal &cranial nerves ; All & none principal , role of neurotransmitters in transmission of nerve impulse
7. Endocrine system: Endocrine & exocrine glands, their location, structure &

functions

Suggested Readings:

7. Anatomy & Physiology- Ross and Wilson
8. Anatomy and Physiology: Understanding the Human Body by Clark
9. Human Anatomy for nurses by Pearce

Biochemical Metabolism

BMLS – 205

THEORY

Aims and Objectives:

This subject shall give information about all the major metabolic pathways occurring in our body. The students will learn the details about metabolism of carbohydrates, proteins, lipids, nucleic acids, enzymes & the deficiency diseases related to them.

Unit -I

1. Carbohydrate Metabolism:

- (a) Introduction, Importance, Classification
- (b) Digestion and absorption
- (c) Metabolism: - Glycolysis, Citric acid cycle, Gluconeogenesis, glycogenolysis, Glycogenesis
- (d) Disorders of carbohydrate metabolism.

Unit- II

2. Protein Metabolism:

- (a) Introduction, Importance, Classification
- (b) Properties of Protein
- (c) Digestion & absorption of Proteins
- (d) Protein synthesis
- (e) Metabolism of proteins
- (f) Disorders of Proteins metabolism and urea cycle

Unit-III

3. Lipid:

- (a) Introduction & Classification
- (b) Digestion & absorption of fats
- (c) Lipoproteins
- (d) Fatty acid biosynthesis & fatty acid oxidation

4. Nucleic Acid:

- (a) Introduction (b) Functions of nucleic acid
- (c) functions of energy carriers.

Unit-IV

5. Enzymes:

- (a) Introductions, Importance & Classifications
- (b) Properties of enzymes
- (c) Mechanism of enzyme action
- (d) Factors affecting enzyme action
- (e) Enzyme kinetics & enzyme inhibitors

Suggested Readings:

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godker
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chaterjee Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet & Voet
9. Biochemistry by Stryer

HUMAN VALUES AND PROFESSIONAL ETHICS-PRACTICAL

HVPE-102

To visit the following places, meet people visiting/living/working in that environment, understand their life style, understand value of human life in each environment and share with them the aspects of their joys and sorrows:

1. Charitable and Government Hospitals
2. Orphanages
3. Old age homes
4. Training Institute for handicapped
5. Drug De-Addiction centers
6. Schools in rural areas
7. Industries
8. Slums
9. Jails

The students shall prepare their project note books during each visit mentioning their experiences about life of the people to whom they visited

Systematic Bacteriology

BMLS - 207

Practical

1. To demonstrate the instruments used to seed culture media
2. To learn techniques for Inoculation of bacteria on culture media
3. To isolate specific bacteria from a mixture of organisms.
4. To demonstrate simple staining (Methylene blue)
5. To prepare India ink preparation to demonstrate negative staining.
6. Bacterial identification : To demonstrate reagent preparation and procedure for
 - (a) Gram stain
 - (b) Albert stain
 - (c) Neisser's staining
 - (d) Z-N staining
 - (e) Capsule staining
 - (f) Demonstration of flagella by staining methods
 - (g) Spore staining
 - (h) To demonstrate spirochetes by Fontana staining procedure
7. To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria:
 - (a) Catalase
 - (b) Coagulase
 - (c) Indole
 - (d) Methyl Red (MR)
 - (e) Voges Proskauer (VP)
 - (f) Urease
 - (g) Citrate
 - (h) Oxidase
 - (i) TSIA
 - (j) Nitrate reduction
 - (k) Carbohydrate fermentation
 - (l) Huger and Leifson

- (m) Bile solubility
- (n) H₂S production
- (o) Demonstration and motility
- (p) Decarboxylases
- (q) CAMP
- (r) Hippurate hydrolysis
- (s) Naglar's reaction

8. To demonstrate Various characteristics (morphological, cultural and biochemical) of bacteria commonly isolated from clinical samples i.e.

- a) Staphylococcus
- b) Streptococcus
- c) Corynebacterium
- d) Escherichia coli,
- e) Klebsiella,
- f) Citrobacter,
- g) Enterobacter,
- h) Proteus
- i) Salmonella
- j) Shigella
- k) Vibrio cholerae
- l) Mycobacterium tuberculosis
- m) Pseudomonas

Basic Haematology Techniques – II

BMLS - 208

Practical

1. To measure the levels of Methaemoglobin, Carboxy and sulphahaemoglobin
2. To determine platelet count of the given sample using phase contrast microscope.
3. To determine PT, PTI, INR and APTT of the given sample.
4. To prepare the following in laboratory
 - a) Brain Thromboplastin, Cephalin, Thrombin, M/40 CaCl₂ and Kaolin Solution.

BMLS – 209

PRACTICAL

1. To study circulatory system from charts and TS of artery and vein from permanent slides.
2. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
3. Study of Urinary system (charts)
4. Study of Genital system (male & female) from charts and TS of testis and ovary from permanent slides.
5. To study nervous system (From models / charts)
6. To study various body fluids.

BMLS – 210

Practical

1. To determine the presence of carbohydrates by Molish test.
2. To determine the presence of reducing sugar by Fehling solutions
3. To determine the presence of reducing sugar by Benedicts method.
4. To determine starch by Iodine test.
5. Determination of Glucose in serum & plasma
6. Estimates of blood Glucose by Folin & Wu method
7. Determination of Urea in serum, plasma & urine.
8. Determination of Creatinine in serum or plasma
9. Determination of serum Albumin
10. Determination of Cholesterol in serum or plasma

B.Sc Medical Laboratory Science
Third Semester

Communication Skills

BMLS-301

Unit-I

1. Communication, its types and significance: Communication, Process of communication its kinds, channels and role in the society.
2. Methods of Communication (Oral, Written, One way, two way communication skills).
3. Reading skills: - Process of reading, reading purpose, models, strategies methodologies, reading activities, structure of meaning techniques.

Unit-II

4. Précis and Communication.
5. Writing skills :- Elements of effective writing, writing styles, scientific and technical writing.
6. Grammar: - Transformation of sentences, words used as different parts of speech, one word substitution, abbreviations, technical terms etc.

Unit-III

7. Listening skills: - Process of listening, barriers to listening, effective listening skills, feedback skills.
8. Speaking skills :- Speech mechanism, organs of speech, production and classification of speech sounds, phonetic transcription, skills of effective speaking components of an effective talk, oral presentation and the role of audio visual aids in it.
9. Reading of text book.

Unit-IV

10. Barriers of communication and technique to overcome those.
11. Meaning of effective communication.
12. Technical Report writing.
13. Practice of writing personal resume and writing application for employment.

Applied Bacteriology

BMLS – 302

THEORY

Aims and Objectives:

The part will cover the strategy in the Laboratory diagnosis of various Infective syndromes i. e. choice of samples, collection and transportation and processing of samples for isolation of bacterial pathogen and then to put antibiotic susceptibility testing. This will also cover Bacteriological examination of water, milk, food and air and nosocomial infections.

Unit-I

1. Laboratory strategy in the diagnosis of various Infective syndromes : Samples of choice, Collection, transportation and processing of samples for laboratory diagnosis of the following complications:
 - a) Septicemia and bacteraemia
 - b) Upper Respiratory tract infections
 - c) Lower Respiratory tract infections
 - d) Wound, skin, and deep sepsis
 - e) Urinary tract infections
 - f) Genital Tract infections
 - g) Meningitis
 - h) Gastro intestinal infections
 - i) Enteric fever
 - j) Tuberculosis (Pulmonary and Extra-pulmonary)
 - k) Pyrexia of unknown origin

Unit-II

2. Antibiotic susceptibility testing in bacteriology
 - a. Definition of antibiotics
 - b. Culture medium used for Antibiotic susceptibility testing
 - c. Preparation and standardization of inoculum
 - d. Control bacterial strains
 - e. Choice of antibiotics
 - f. MIC and MBC : Concepts and methods for determination
 - g. Various methods of Antibiotic susceptibility testing with special reference to **Stokes method** and **Kirby-Bauer method**
 - h. Tests for production of ***β-lactamase***

3. Bacteriological examination of water, milk, food and air
 - a. Examination of water
 - a) Collection and transportation of water sample
 - b) Presumptive coliform count
 - c) Eijkman test
 - d) Introduction and importance of other bacteria considered as indicators of faecal contamination
 - e) Membrane filtration tests
 - f) Interpretation of results
 - b. Examination of Milk and milk products
 - a) Basic Concepts regarding gradation of milk
 - b) Various tests for Bacteriological examination
 - c. Examination of food articles
 - a) Basic Concepts regarding classification of food like frozen food, canned food, raw food, cooked food etc.
 - b) Various tests for Bacteriological examination with special reference to food poisoning bacteria
 - d. Examination of Air
 - a) Significance of air bacteriology in healthcare facilities
 - b) Settle plate method
 - c) Types of air sampling instruments
 - d) Collection processing and reporting of an air sample

Unit-III

4. Sterility testing of I/v fluids
 - a. Collection, transportation and processing of I/v fluids for bacterial contamination
 - b. Recording the result and interpretation

5. Nosocomial Infection :

- a) Introduction, sources and types of nosocomial infections.
- b) Bacteriological surveillance of hospital environment.
- c) Role of microbiology laboratory in control of nosocomial infections

Unit-IV

6. Epidemiological markers:

- a. Serotyping,
- b. Phage typing and
- c. Bacteriocin typing.

7. Preservation methods for microbes

- a. Basic concepts of preservation of microbes
- b. Why do we need to preserve bacteria
- c. Principle and procedures of various preservation methods with special reference to lyophilization.

Suggested Readings:

- 15. Practical Medical Microbiology by Mackie & MacCartney Volume 1 and 2
- 16. Text book of Microbiology by Ananthanereyan
- 17. Medical Microbiology by Paniker & Satish Gupte
- 18. Medical laboratory Technology vol.I ,II, III by Mukherjee
- 19. Medical Laboratory manual for tropical countries Vol II Microbiology by Monia Cheesbrough
- 20. Hospital Acquired Infections by Dr. V Muralidhar

Applied Haematology-1

BMLS-303

Aims and objectives:

The students be made aware of Safety precautions, Quality assurance, biomedical waste management and automation in haematology. It will also cover Bone marrow examination, Red cell anomalies, Disorder of leucocytes, L.E.cell phenomenon, Investigations of a case suffering from bleeding disorders, routine examination of urine, seminal fluid and CSF.

Unit-I

1. Quality assurance in haematology.
 - a. Internal and external quality control including reference preparation b. Routine quality assurance protocol
 - c. Statistical analysis i.e. Standard deviation, Co-efficient variation, accuracy and precision
2. Safety precautions in haematology
3. Basic concepts of automation in haemotology with special reference to:
 - a. Blood cell counter b. Coagulometer

Unit-II

4. Red cell anomalies
 - a. Morphological changes such as variation in size shape & staining character.
5. Disorder of leucocytes.
 - a. Abnormal morphology i.e. shift to left & shift to right.
6. Bone marrow examination
 - a. Composition and functions
 - b. Aspiration of bone marrow (Adults and children)
 - c. Processing of aspirated bone marrow (Preparation & staining of smear)
 - d. Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios)
 - e. Processing and staining of trephine biopsy specimens

7. L.E.cell phenomenon.
 - a. Definition of L.E.cell.
 - b. Demonstration of L.E.cell by various methods.
 - c. Clinical significance.

8. Physiological variations in Hb, PCV, TLC and Platelets

9. Investigations of a case suffering from bleeding disorders

10. Quantitative assay of coagulation factors
 - a. Principle
 - b. Procedure

Unit-IV

11. Routine examination of urine

12. Routine examination of seminal fluid

13. Routine examination of CSF and other body fluids *i.e.* pleural, peritoneal and synovial fluid etc.
14. Biomedical waste management in haematology laboratory (Other than Radioactive material)

Suggested readings

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Practical Haematology by JB Dacie
3. Hand book of Medical Laboratory Technology (IInd edition) by V.H. Talib
4. Haematology (International edition) Emmanuel C.Besa Harwal Publisher
5. Practical Haematology (8th edition) by Sir John
6. Clinical Haematology by Christopher A. Ludlam
7. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard
 - a. Henery
8. Medical Laboratory Technology Methods & Interpretation (5th edition) by Ramnik Sood
9. Atlas of haematology (5th edition) by G.A. McDonald
10. A Manual of Laboratory & Diagnostic Tests (6th edition) by Frances Fischbach
11. Haematology (Pathophysiological basis for clinical practice) 3rd edition, by Stephen M.
 - a. Robinson .
12. Short Text Book of Haematology by Dr Balbir Shah and Preeti Bajaj. Edition 2014, CBC Publication

**Basic Cellular
Pathology**

**BMLS-
304**

Aims and Objectives:

The student will study diseases associated with different body organs and systems

Unit-I

1. **Alimentary System:** - Diseases of mouth, Diseases of Oesophagus- Oesophageal varices.
2. **Digestive System:-** Gastritis, Peptic ulceration, Appendicitis microbial diseases, food poisoning, hernia, Intestinal abstrictions & malabsorbtion.
3. **Accessory Digestive glands:** - **Salivary glands-** mumps, **liver** – hepatitis, liver failure, cirrhosis. **Pancreas-** pancreatitis. **Gall Bladder-** Gall stones, jaundice and cardiovascular diseases.

Unit-II

4. **Circulatory System:-** Diseases of Blood vessels- Atheroma, Arteriosclerosis, heart block. Disorders of Blood Pressure-Hyper & Hypotension.
5. **Respiratory System:** - Upper respiratory tract infection, Bronchi, Asthma, Pneumonia, Lung abscess, Tuberculosis, Lung Collapse.
6. **Urinary System:** - Glomerulonephritis, Nephrotic syndrome, Renal failure, Renal calculi, Urinary obstruction, Urinary tract infection.

Unit-III

7. **Reproductive system:-** Sexually transmitted diseases, Pelvic inflammatory disease, disorder of cervix(CIN), Disease of ovaries, ectopic pregnancy, prostatitis, Infertility
8. **Nervous System:** - Neuronal damage, ICP, Cerebral Infarction, head injury, Alzheimer's disease, dementia.

Unit-IV

9. **Endocrine System:-** Pituitary:- Hyper & Hypo secretions

Thyroid: - Goiter

Adrenal: - Cushing Syndrome, Addison Disease

Pancreas: - Diabetes

10. **Sense Organs:-** Ear:- Otitis

Eye: - Cataract

Suggested readings:

1. Anatomy & Physiology- Ross and Wilson
2. Human Anatomy and Physiology by Pearce
3. Di Fiore's Atlas of Histology
4. Medical Laboratory technology-Volume III
5. Color atlas of basic Histopathology
6. Immunology-Kuby
7. Text book of Pathology
8. Clinical Pathology
9. Functional Histology
10. Text book of Histology

Analytical Biochemistry

BMLS-305

Aims and Objectives:

The students will learn basic principle/ mechanisms, procedures and types of various techniques commonly performed in analytical biochemistry.

Unit- I

1) Spectrophotometry and colorimetry:

- (a) Introduction
- (b) Theory of spectrophotometry and colorimetry,
- (c) Lambert`s law and Beer`s law
- (d) Applications of

2) Photometry:

- (a) Introduction (b) General principles of flame photometry
- (c) Limitations of flame photometry
- (d) Instrumentation
- (e) Applications of flame photometry
- (f) Atomic absorption spectroscopy- Principle and Applications

Unit-II

3) Chromatography: Introduction, definition, types of chromatography

- a) **Paper Chromatography:** Introduction, principle, types, details for qualitative and quantitative analysis, application
- b) **Thin layer chromatography:** Introduction, experimental techniques, application of TLC, limitations, High performance thin layer chromatography

Unit- III

- c) **Column chromatography:** Introduction, principle column efficiency, application of column chromatography
- d) **Gas chromatography:** Introduction, Principle, instrumentation, limitations and applications.
- e) **Ion exchange chromatography:** Introduction, Definition and Principle, cation and anion exchangers, application
- f) **Gel Chromatography:** Introduction, Principle and method, application and advantages

Unit-IV

- 4) **Electrophoresis:** Introduction, principle, Instrumentation, types of electrophoresis - paper and gel electrophoresis, application

Suggested readings:

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godker
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chaterjee Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet & Voet
9. Biochemistry by Stryer

Communication Skills
BMLS-306

Practical

1. To study propose text book.
2. Precis writing and simple passage from a prescribed text books. At least 100 words should be chosen and few questions from the passage may be said to answer.
3. To practice all forms communication i.e. drafting report, agenda notes, précis writing, telegram, circular, representations, press release, telephonic communication, practice of writing resume and writing application of employment.

Applied Bacteriology

BMLS – 307

PRACTICALS

1. Inoculation of different culture media
2. Isolation of pure cultures
3. Processing of following clinical samples for culture and identification of pathogens:
 - Blood
 - Throat swab
 - Sputum
 - Pus
 - Urine
 - Stool for Salmonella, Shigella and Vibrio cholerae
 - C.S.F. and other body fluids

4. Antimicrobial susceptibility testing
 - a. Introduction and terms used
 - b. Preparation and standardization of inoculum
 - c. To demonstrate reference bacterial strains
 - d. Choice of antibiotics
 - e. To determine MIC and MBC a known bacteria against a known antibiotic
 - f. To perform antibiotic susceptibility testing of clinical isolates by using
 - a) **Stokes method** and b) **Kirby-Bauer method**
 - g. To perform any one test to demonstrate the production of ***β-lactamase***

5. Collection, transportation and processing of :
 - a. water,
 - b. milk ,
 - c. food and
 - d. air samples for bacteriological examination

6. To demonstrate sterility testing of intravenous fluid with positive and negative controls

7. Demonstration of serotyping and bacteriocin typing
8. Demonstration of lyophilization
9. To learn 'How to dispose of bacterial cultures'

Applied Haematology-1

BMLS-308

Practical

1. To prepare a bone marrow smear and stain by Leishman's, May Grunwald Giesma and Perl's stain.
2. To process a bone marrow trephine biopsy cut sections and stain with H &E, Reticulin stain and PAS staining
3. To identify morphologically the:
 - (i) Immature Erythroid series of cells.
 - (ii) Immature Myeloid and other WBC series of cells.
4. To study the RBCs abnormal morphological forms.
 - (i) Variation in size, shape & Staining character
 - (ii) Red cell inclusion.
5. To collect blood & test it for the presence of LE cell from a suspected DLE patient.
6. Preparation of various additive reagents used in mixing experiments
 - a. Correction studies / mixing experiments to pin point the defect in case of prolonged
 - i. PT
 - ii. APTT
 - iii. Thrombin time
7. Physical, Chemical and Microscopic examination of urine
8. Cytological examination of CSF and other body fluids
9. Physical and Microscopic examination of seminal fluid including sperm count
10. Demonstration of functional aspects of blood cell counter
11. Demonstration of functional aspects of Coagulometer

Basic Cellular Pathology

BMLS- 309

PRACTICAL

1. To study squamous cell from cheek cells
2. To study stained slide preparation from organs of digestive system
3. Study of stained slides of liver, pancreas ,gall bladder
4. Study of various types of microscope
5. To study stained slide preparation from organs of circulatory system
6. To study stained slide preparation from organs of Respiratory system
7. To study stained slide preparation from organs of Nervous system
8. To study stained slide preparation from organs of Urinary system
9. To study stained slide preparation from organs of Endocrine system

BMLS-310

(PRACTICAL)

- a) To demonstrate the principle, working & maintenance of spectrophotometer.
- b) To demonstrate the principle, working & maintenance of colorimeter.
- c) To demonstrate the principle, working & maintenance of flame photometer.
- d) To demonstrate the principle, procedure of paper chromatography.
- e) To demonstrate the principle & procedure of Gas chromatography.
- f) To demonstrate the principle & demonstration of TLC.
- g) To demonstrate the principle & procedure of column chromatography.
- h) To demonstrate the principle & procedure of Electrophoresis.

B.Sc Medical Laboratory Science
Fourth Semester

BMLS-401

Aims and Objectives:

These days almost all the laboratory instruments and even laboratory office management is controlled by computers. Hence this part of this course will provide the theoretical and working knowledge about use of computers in Medical Laboratory Sciences.

Unit-I

Introduction to computer: introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.

Input output devices: input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems).

Processor and memory: The Central Processing Unit (CPU), main memory.

Storage Devices: sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.

Unit-II

Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.

Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.

Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

Unit-III

Introduction of Operating System: introduction, operating system concepts, types of operating system.

Introduction to MS-DOS: History of DOS, features of MS-DOS, MS-DOS Commands (internal and external).

Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).

Unit-IV

Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.

Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.

Application of Computers in various fields: Medical, Education, Railway, Defense, Industry, Management, Sports, Commerce, Internet.

Introduction to installation of different software and introduction about different software related to MLS.

Immunology and Mycology

BMLS – 402

Aims and Objectives:

This section will cover the basic aspects of immunity, antigens, antibodies, various serological reactions, techniques and their utility in laboratory diagnosis of human diseases. It will also cover medically important fungi, infections caused by them and their laboratory diagnosis.

THEORY

Unit-I

1. History and introduction to immunology
2. Immunity
 - a. Innate and acquired immunity including basic concepts about their mechanisms
3. Definition, types of antigens and Determinants of antigenicity
4. Definition, types, structure and properties of immunoglobulins
5. Antigen-Antibody reactions
 - a. Definition, Classification , general features and mechanisms and applications of various antigen antibody reactions
6. Principle, procedure and applications of Complement fixation test, Immuno-fluorescence, ELISA, CIEP, and RIA, SDS-PAGE and western blotting in Medical Microbiology

Unit-II

7. Principle, procedure and interpretation of various serological tests *i.e.* Widal, VDRL, ASO, CRP, Brucella tube agglutination and Rose-Waaler
8. Raising of high titer antisera in laboratory animals and its standardization

9. Complement system: Definition and Basic concepts about its components and complement activation pathways
10. Immune response : Introduction & Basic concepts of Humoral and Cellular immune responses
11. Hypersensitivity: Definition and Types of hypersensitivity reactions
12. Basic concepts of autoimmunity and brief knowledge about autoimmune diseases
13. Vaccines: Definition, Types, Vaccination schedule and Brief knowledge about '*Extended programme of immunization*' (EPI) in India.

Unit-III

14. Introduction to medical mycology
15. Basic concepts about superficial and deep Mycoses
16. Taxonomy and classification and general characteristics of various medically important fungi
17. Normal fungal flora
18. Morphological, cultural characteristics of common fungal laboratory contaminants
19. Culture media used in mycology
20. Direct microscopy in Medical mycology laboratory

Unit-IV

21. Processing of clinical samples for diagnosis of fungal infections i.e. Skin, nail, hair, pus, sputum, CSF and other body fluids
22. Techniques used for isolation and identification of medically important fungi

23. Methods for identification of yeasts and moulds

24. Dimorphism in fungi
25. Use of laboratory animal for diagnosis of fungal infections
26. Antifungal susceptibility tests
27. Preservation of fungal cultures
28. Routine myco-serological tests and skin tests

Suggested Readings:

21. Practical Medical Microbiology by Mackie & MacCartney Volume 1 and 2
22. Text book of Microbiology by Ananthanereyan
23. Medical Microbiology by Paniker & Satish Gupte
24. Medical laboratory Technology vol.I ,II, III by Mukherjee
25. Medical Laboratory manual for tropical countries Vol II Microbiology by Monia Cheesbrough
26. Immunology by Ivan Roitt, Jonathaan Brostoff and David Male
27. Immunology by Kuby
28. Medical Mycology by Dr Jagdish Chander

Aims and Objectives:

Theory

Unit-I

1. Definition and classification of anaemias.
2. Laboratory diagnosis of iron deficiency anaemia
3. Laboratory diagnosis of megaloblastic anaemia
4. Laboratory diagnosis of haemolytic anaemia

Unit-II

5. Definition, classification and laboratory diagnosis of leukaemias
6. Definition and laboratory diagnosis of Leukamoid reactions
7. Cytochemical stainings, procedure and their significance in various haemopoietic disorders.
8. Chromosomal studies in various haematological disorders and their significance.

Unit-III

9. Mechanism of normal fibrinolysis and Laboratory diagnosis of hyperfibrinolysis.
10. Mechanism and laboratory diagnosis of disseminated intravascular coagulation (DIC).
11. Laboratory diagnosis of Haemophilia and von-willebrand disease.
12. Laboratory diagnosis of Idiopathic thrombocytopenic purpura (ITP)
13. Platelet function tests and their interpretation.

14. Various radioactive isotopes used in haematology
 - a) Definition, source, half life and their application
 - b) Units of radiation measurement *i.e* Curie, millicurie and microcurie c)
What is Rad?
15. Various Apparatus used for measurement of Radiation:
 1. Principle and their uses
16. Measurement of:
 - a. Blood volume
 - b. Determination of Red cell volume and Plasma volume
 - c. Red cell life span
 - d. Platelet life span
17. Radiation hazards and its prevention
18. Disposal of radioactive material

Suggested readings

23. Text book of Medical Laboratory Technology by Paraful B. Godkar
24. Practical Haematology by JB Dacie
25. Hand book of Medical Laboratory Technology(IIInd edition) by V.H. Talib
26. Haematology (International edition)Emmanuel C.Besa Harwal Publisher
27. Practical Haematology(8th edition) by Sir John
28. Clinical Haematology by Christopher A. Ludlam
29. Clinical Diagnosis &Management by Laboratory methods(20th edition) by John bernard Henary
30. Medical Laboratory Technology Methods &Interpretation(5th edition) by Ramnik Sood
31. Atlas of haematology(5th edition)by G.A. McDonald
32. A Manual of Laboratory & Diagnostic Tests(6th edition)by Frances Fischbach
33. Haematology (Pathophysiological basis for clinical practice) 3rd edition, by Stephen M. Robinson .

HISTOTECHNOLOGY-I

BMLS-404

Theory

Aims and Objectives:

In this section students will be made aware of terminology used in histotechnology, various instruments and their maintenance and also learn the processing of various samples for histopathological investigations.

Unit-I

1. Introduction to histotechnology
2. Care and maintenance of laboratory equipment used in histotechnology
3. Safety measures in a histopathology laboratory
4. Basic concepts about routine methods of examination of tissues
5. Collection and transportation of specimens for histological examination

Unit-II

6. Basic concepts of fixation
7. Various types of fixatives used in a routine histopathology laboratory
 - i. Simple fixatives
 - ii. Compound fixatives
 - iii. Special fixatives for demonstration of various tissue elements
8. Decalcification
 - a. Criteria of a good decalcification agent
 - b. Technique of decalcification followed with selection of tissue, fixation, decalcification, neutralization of acid and thorough washing.
 - c. Various types of decalcifying fluids: Organic & Inorganic Acid, chelating agents, Use of Ion-exchange resins and Electrophoretic decalcification and treatment of hard tissues which are not calcified.

Unit-III

9. Processing of various tissues for histological examination
 - a. Embedding

- i. Definition
- ii. Various types of embedding media
- iii. Procedure followed by Dehydration, Clearing, Infiltration and routine timing schedule for manual or automatic tissue processing.
- iv. Components & principles of various types of automatic tissue processors

10. Section Cutting

- a. Introduction regarding equipment used for sectioning
- b. Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping, various types of microtome and their applications
- c. Freezing Microtome and various types of Cryostats.
- d. Faults in paraffin section cutting with reason and remedy, spreading the sections and attachment or mounting of sections to glass slides.

Unit-IV

11. Staining, Impregnation and Mountants

- a. Theory of Staining, Classifications of Dyes, Principles of Dye Chemistry,
- b. Stains and Dyes and their uses,
- c. Types of Stains, Chemical Staining Action, Mordants and Accentuators, Metachromasy.
- d. Use of Controls in Staining Procedures,
- e. Preparation of Stains, solvents, aniline water and buffers etc.,
- f. Commonly used mountants in histotechnology lab.
- g. General Staining Procedures for Paraffin Infiltrated and Embedded tissue.
- h. Nuclear Stains and Cytoplasmic stains
- i. Equipment and Procedure for manual Staining and Automatic Staining Technique.
- j. Mounting of Cover Slips, Labeling and Cataloguing the Slides.

12. Routine Staining Procedures

- a. Haematoxylin and Eosin Staining, various types of Haematoxylins
- b. Mallory's Phosphotungstic Acid Haematoxylin (PTAH)

Suggested Readings:

BMLS – 405

Aims and Objectives:

Theory

Unit- I

1. Hazards & safety measures in clinical Biochemistry laboratory.
2. Quality control and quality assurance in a clinical biochemistry laboratory
3. Laboratory organization, management and maintenance of record.

Unit-II

4. Principles of assay procedures for: - Normal range in blood, Serum, Plasma and Urine and reference values for.
 - a. Glucose
 - b. Proteins
 - c. Urea
 - d. Uric acid
 - e. Creatinine
 - f. Bilirubin
 - g. Lipids

Unit-III

5. Principles, procedures for estimation & assessment of the following including Error involved and their corrections
 - a. Sodium, Potassium and Chloride, Iodine.
 - b. Calcium, Phosphorous and Phosphates

Unit- IV

6. Instruments for detection of Radioactivity.
7. Applications of Radioisotopes in clinical biochemistry.
8. Enzyme linked Immunosorbent assay.

Suggested Readings:

1. Text book of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Sciences, Theory & Practical by A. Kolhatkar.
3. Practical Clinical Biochemistry by Harold Varley.
4. Biochemistry, U. Satyanarayan. & U. Chakrapani.
5. Text book of Medical Biochemistry by Chaterjee & Shinde.

Fundamentals of Computers-I

BMLS- 406

Practicals:

Learning to use MS Office: MS WORD, MS EXCEL & MS PowerPoint.

Immunology and Mycology

BMLS – 407

PRACTICAL

1. Collection of blood sample by vein puncture, separation and preservation of serum
2. Raising haemolysin in Rabbit and performing its titration for Rose-Waaler test
3. Preparation of Phosphate buffers, Vernol buffer, ASO buffer, Richardsons buffer, Buffers of different pH and molarity, tris buffer, Standardization of cell concentration by spectrophotometer
4. Performance of Serological tests *i.e.*
 - a. Widal,
 - b. Brucella Tube Agglutination,
 - c. VDRL (including Antigen Preparation),
 - d. ASO (Antistreptolysin 'O')
 - e. C-Reactive Protein (Latex agglutination)
 - f. Rheumatoid factor (RF) Latex agglutination
 - g. Rose Waaler test,
5. Demonstration of antigen / antibody determination by Immunofluorescence, Immunodiffusion, precipitation in agarose gel(ouchterlony), CCIEP, ELISA, SDS-PAGE and western blotting.
6. To prepare culture media used routinely in mycology
7. To perform all the staining techniques for identification of fungi as mentioned in theory syllabus.
8. To identify given yeast culture (By performing various identification techniques studied in theory.
9. To identify given mould culture (By performing various identification techniques studied in theory.
10. To demonstrate dimorphism in fungi
11. To process clinical samples for laboratory diagnosis of fungal infections *i.e.*
 - a) Skin
 - b) Nail
 - c) Hair
 - d) Body fluids and secretions
12. To use mice for lab diagnosis of any fungal infection

Applied Haematology – II

BMLS – 408

Practical

1. To estimate serum iron and total iron binding capacity.
2. To detect whether the given specimen is G6PD deficient or normal.
3. To estimate Hb-F in a given blood sample.
4. To estimate plasma and urine Haemoglobin in the given specimens.
5. To demonstrate the presence of Hb-S by Sickling and solubility tests.
6. To test the given blood sample for its osmotic red cell fragility.
7. Cytochemical staining on the given smears such as PAS, SBB, MPO, LAP and Perl's reaction.
8. Estimation of Fibrinogen, Fibrin degradation products (FDPs) and Euglobulin clot lysis test (ELT)
9. Urea clot solubility test for factor XIII.
10. To perform various platelet function tests such as whole blood clot retraction test, prothrombin consumption index (PCI) Platelet adhesion, aggregation and PF3 availability test.

HISTOTECHNOLOGY-I

BMLS-409

Practical

1. Demonstration of instruments used for dissection
2. Use of antiseptics, disinfectants and insecticides in a tissue processing laboratory
3. Reception and labeling of histological specimens
4. Preparation of various fixatives
 - a. Helly's fluid
 - b. Zenker's fluid
 - c. Bouin's fluid
 - d. Corney's fluid
 - e. 10% Neutral formalin
 - f. Formal saline
 - g. Formal acetic acid
 - h. Pereyn's fluid
5. To perform embedding and casting of block
6. To process a bone for decalcification
7. To prepare 70% alcohol from absolute alcohol
8. Processing of tissue by manual and automated processor method
9. To demonstrate various part and types of microtome
10. To learn sharpening of microtome knife (Honing and stropping technique)
11. To perform section cutting
12. To practice attachment of tissue sections to glass slides
13. To learn using tissue floatation bath drying of sections in incubator (-56⁰C)
14. To perform & practice the Haematoxylin and Eosin staining technique
15. To perform & practice the Mallory's Phosphotungstic Acid Haematoxylin (PTAH)
16. To learn mounting of stained smears

BMLS – 410

Practical

1. Estimation of Glucose in Urine and in Blood.
2. Estimation of Protein in Urine and Blood.
3. Estimation of Urea in blood.
4. Estimation of uric acid in blood.
5. Estimation of serum bilirubin
6. Estimation of Total Cholesterol in blood.
7. Estimation of HDL Cholesterol.
8. Estimation of LDL Cholesterol.
9. Estimation of TG
10. Estimation of Creatinine in Blood
11. Estimation of serum calcium
12. To measure electrolytes Sodium, Potassium & Chloride.

B.Sc Medical Laboratory Science
Fifth Semester

Medical Laboratory
Management

BMLS-
501

Aims and Objectives: The students will become aware of ethics in a clinical laboratory, Good laboratory practice and Quality Management in a clinical laboratory.

Unit-I

1. Ethical Principles and standards for a clinical laboratory professional
 - a. Duty to the patient
 - b. Duty to colleagues and other professionals
 - c. Duty to the society
2. Good Laboratory Practice (GLP) Regulations and Accreditation
 - a. Introduction to Basics of GLP and Accreditation
 - b. Aims of GLP and Accreditation
 - c. Advantages of Accreditation
 - d. Brief knowledge about Nation and International Agencies for clinical laboratory accreditation
3. Awareness / Safety in a clinical laboratory
 - a. General safety precautions
 - b. HIV : pre- and Post-exposure guidelines
 - c. Hepatitis B & C : pre- and Post-exposure guidelines
 - d. Drug Resistant Tuberculosis

Unit-II

4. Patient management for clinical samples collection, collection of sample, transportation and preservation
5. Sample accountability
 - a. Purpose of accountability
 - b. Methods of accountability
6. Sample analysis
 - a. Introduction
 - b. Factors affecting sample analysis
7. Reporting results
 - a. Basic format of a test report
 - b. Reported reference range

- c. Clinical Alerts
- d. Abnormal results
- e. Turnaround time
- f. Results from referral laboratories
- g. Release of examination results
- h. Alteration in reports

Unit-III

- 8. Quality Management system
 - a. Introduction
 - b. Quality assurance
 - c. Quality control system
 - d. Internal and External quality control
- 9. Biomedical waste management in a clinical laboratory
- 10. Introduction and importance of calibration and Validation of Clinical Laboratory instruments

Unit-IV

- 11. Laboratory Information system and financial Management
 - a. Introduction
 - b. Functions of a laboratory management system
 - c. Standards for laboratory management system
 - d. Introduction and awareness of financial management in a clinical laboratory
- 12. Ethics in Medical laboratory Practice
 - a. Understanding the term 'Ethics'
 - b. Ethics in relation to the following:
 - i. Pre-Examination procedures
 - ii. Examination procedures
 - iii. Reporting of results
 - iv. Preserving medical records
 - v. Access to Medical laboratory Records
- 13. Audit in a Medical Laboratory
 - a. Introduction and Importance
 - b. Responsibility
 - c. Planning
 - d. Horizontal, Vertical and Test audit
 - e. Frequency of audit
 - f. Documentation

PARASITOLOGY AND VIROLOGY

BMLS-502

Aims and Objectives: The student will be taught about introduction, general characteristics, life cycle and laboratory diagnosis of various Medically important parasites. They also learn about diseases caused by medically important viruses, samples collection and laboratory diagnosis of some important viral infections.

Unit-I

1. Introduction to Medical Parasitology
2. General characteristics of protozoa and helminthes
3. Collection, Transport, processing and preservation of samples for routine parasitological investigations

Unit-II

4. Morphology, life cycle and lab-diagnosis of Giardia and Entamoeba
5. Morphology, life cycle and lab-diagnosis of Roundworms and Hookworms
6. Morphology, life cycle and lab-diagnosis of T. solium and T. saginata

Unit-III

7. Morphology, life cycle and lab-diagnosis of Malarial parasite with special refrence to P.vivax and P.falciparum
8. Laboratory diagnosis of hydrated cyst and cysticercosis
9. Concentration techniques for demonstration of Ova (Principles and applications)

Unit-IV

10. Introduction to medical virology
11. Classification of viruses.
12. Introduction to medically important viruses
13. Collection, transportation and storage of sample for viral diagnosis
14. Staining techniques used in Virology
15. Processing of samples for viral diagnosis (Egg inoculation and tissue culture)

Blood Banking

BMLS-503

Aims and objectives:

This subject will make students learn about blood grouping & blood transfusion. The students will learn about the concept of blood grouping, compatibility testing in blood transfusion & screening of donated blood for various infectious diseases.

Unit-I

1. Introduction to Blood Banking
2. History and discovery of various blood group systems
3. ABO and Rh blood group system
4. Sources of error in blood grouping and their elimination.
5. Difference between Complete and incomplete antibodies
6. Tests for secretion of A or B substance
7. Titration of various antisera
8. Precautions while procurement and storage of grouping antisera

Unit-II

9. Various anticoagulants used to collect blood for transfusion purposes
10. Procedure for collection of blood from a healthy donor
11. Compatibility test in blood transfusion
 - a) Collection of blood for cross matching from a blood bag
 - b) Major cross matching
 - c) Minor cross matching
 - d) Use of enzymes in blood bank specially Pepain

Unit-III

12. Complications and hazards of blood transfusion
13. Laboratory investigations of transfusion reactions and mismatched blood transfusion including direct and indirect Coomb's tests.

Unit-IV

14. Preparation of various fractions of blood for transfusion and therapeutic purposes such as:
 - a) Packed red cells, washed red cells and FROZEN Red cells
 - b) Platelet Rich Plasma (PRP), Platelet concentrate and Frozen platelets.
 - c) Fresh plasma(PPP), Fresh Frozen Plasma(FFP) and cryoprecipitate
15. Brief introduction of blood substitute/artificial blood
16. Haemapheresis : pertaining to Leucocytes, platelets and plasma.
17. Quality control in blood bank

HISTOTECHNOLOGY – 2 & Cytology

BMLS-504

Aims and Objectives:

The students will learn about various staining procedures for demonstration of different substances & various cytological investigations. The students will learn about special staining procedures & handling & testing of various cytological specimens.

Unit-I

1. Cryostat sectioning, its applications in diagnostic histopathology.
2. 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 toluidine 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
3. Demonstration of Proteins & nucleic acids.

Unit-II

4. Demonstration of Carbohydrates, lipids, fat & fat like substances.
5. Demonstration of bacteria and fungi in tissue section.
6. 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

7. Enzyme histochemistry : Diagnostic applications & demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases.
8. Vital staining.
9. Neuropathological techniques.
10. Museum techniques.

Unit-IV

11. Aspiration cytology principles, indications & utility of the technique with special

emphasis on role of cytotechnologist in FNAC clinics, fluid cytology

12. Exfoliative cytology (Papanicolaou technique for the staining of cervical smears.)
13. Introduction and importance of Autoimmune disorders, HLA typing, T & B Cells, ANA, ANCA and TMA
14. Cancer immunology.
15. Tissue typing for kidney transplant.

BMLS-505

Aims and objectives:

The students will learn about the various methods of patients' sample analysis for biochemistry parameters. The students will learn how to analyze various clinical samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important enzymes & automation techniques.

Unit-I

1. Automation in clinical Biochemistry Laboratory
2. Brief knowledge about rapid techniques in Clinical Biochemistry

Unit-II

3. Method of estimation and assessment for:
 - a. Glucose tolerance test.
 - b. Insulin tolerance test.
 - c. Xylose excretion test.
4. Gastric analysis.
5. Clearance test for renal function.

Unit-III

6. Qualitative test for urobilinogens, Barbiturates, T3, T4 and TSH, 17 Ketosteroids.
7. Principles, clinical significance and procedures for estimation of acid phosphatase, Alkaline phosphatase, lactate dehydrogenase, aspartate transaminase, alanine transaminase, Creatine phosphokinase.

Unit- IV

8. Qualitative analysis of renal calculi.
9. Chemical examination of cerebrospinal fluid.

Medical Laboratory Management

BMLS-506

1. Clinical sample collection e.g.
 - a. Blood
 - b. Urine
 - c. Stool examination
 - d. Saliva sample
 - e. Sputum sample
 - f. Semen analysis etc.
2. Sample accountability
 - a. Labeling of sample
 - b. Making entries in Laboratory records
3. Reporting results
 - a. Basic format of a test report
 - b. Release of examination results
 - c. Alteration in reports
4. Quality Management system
 - a. Internal and External quality control
5. Biomedical waste management in a clinical laboratory
 - a. Disposal of used samples, reagents and other biomedical waste
6. Calibration and Validation of Clinical Laboratory instruments
7. Ethics in Medical laboratory Practice
 - a. Ethics in relation to the following:
 - i. Pre-Examination procedures
 - ii. Examination procedures
 - iii. Reporting of results
 - iv. Preserving medical records
 - v. Access to Medical laboratory Records
8. Audit in a Medical Laboratory
 - a. Documentation

Suggested Readings:

1. Medical Laboratory Management, by Sangeeta Sharma et.al, Viva Books Pvt Ltd. 4737/23, Ansar Road, Daryaganj, New Delhi
2. Clinical Laboratory Management, by Lynne Shore Garcia, ISBN Number 978-1-55581-279-9

PARASITOLOGY AND VIROLOGY

BMLS-507

1. Routine stool examination for detection of intestinal parasites with concentration methods:
 - Saline preparation
 - Iodine preparation
 - Floatation method
 - Centrifugation method
 - Formal ether method
 - Zinc sulphate method
2. Identification of adult worms from models/slides:
 - Tapeworm
 - Tapeworm segments
 - Ascaris
 - Hookworms
 - Pinworms
3. Malarial parasite:
 - Preparation of thin and thick smears
 - Staining of smears
 - Examination of smears for malarial parasites(P.Vivax and P.falciparum)
 - Demonstration of various stages of life cycle of malarial parasites from stained slides
4. Demonstration of fertilized hen egg
5. Demonstration of various inoculation routes in fertilized hen egg
6. Inoculation of fertilized hen egg through various routes.

Suggested readings:

1. Text book of Parasitology by NC Dey
2. Text book of Parasitology by Chaterjee
3. Medical parasitology by RL Ichhpujani and Rajesh Bhatia
4. Text book of Microbiology by Ananthanereyan
5. Medical Microbiology by Paniker & Satish Gupte
6. Text book of Microbiology by DR arora

7. Basic Medical Laboratory techniques by Barbara H. Estridge et.al

Blood Banking

BMLS-508

Practical

1. To prepare Acid Citrate Dextrose (ACD) and Citrate Phosphate Dextrose (CPD) Solutions
2. Screening of blood donor: physical examination including medical history of the donor
3. Collection and preservation of blood for transfusion purpose
4. Screening of blood for Malaria, Microfilaria, HBsAg, syphilis and HIV
5. To determine the ABO & Rh grouping
 - a) Direct or preliminary grouping
 - b) Indirect or proof grouping
 - c) Rh grouping and determination of Du in case of Rh negative
6. To perform Direct and Indirect Coomb's test
7. To perform cross matching
 - a) Major cross matching
 - b) Minor cross matching
8. Preparation of various fractions of blood.

Suggested readings:

1. Practical haematology by JB Dacie
2. Transfusion Science by Overfield, Hamer
3. Medical laboratory Technology by KL Mukherjee Volume-I
4. Haematology for students Practitioners by Ramnik Sood

HISTOTECHNOLOGY – 2 & Cytology

BMLS- 509

Practicals

1. To cut frozen section and stain for haematoxylin and eosin, metachromatic stain toluidine blue-'o' and oil red 'o' staining for the demonstration of fat
2. To prepare schiff's reagent in the lab and do Per iodidic Acid schiff's stain on a paraffin section
3. To prepare ammonical silver bath in the laboratory and stain paraffin embedded section for the demonstration of reticulin fibers.
4. To stain a paraffin section for the demonstration of smooth muscle van gieson's stain
5. To perform masson's trichrome stain on a paraffin section for the demonstration of collagen, muscle fibre and other cell elements.
6. To stain the paraffin section for the demonstration for the elastic fibres(EVG).
7. To stain Decalcified paraffin embedded section for the presence of calcium salts (Von Kossa's method).
8. To stain a paraffin section for the following mucicarmin, alsiian blue.
9. To stain a paraffin section for the demonstration of iron (perl's stain)
10. To demonstrate the presence of bacteria and fungi in paraffin embedded sections the following staining procedures:
 - a) Gram's staining
 - b) AFB staining (Zeil Neilson's staining)
 - c) Grocott's stain for fungi
 - d) Schamori's reaction for reducing substances (melanin)
11. To stain for nucleic acid (DNA and RNA)
12. To perform Papnicolaou's stain on cervical smear
13. To perform Guard's staining for demonstration sex chromatin (barr bodies on a buccal smear)

Suggested readings:

1. Medical laboratory Technology by KL Mukherjee Volume-III
- 2.

CLINICAL BIOCHEMISTRY--II

BMLS-510

PRACTICAL

1. Estimation of Glucose tolerance test (GTT).
2. Estimation of Insulin tolerance test (ITT).
3. Determination of Uric acid in Urine.
4. Determination of Creatinine clearance.
5. Determination of Urea clearance.
6. Determination of Serum acid phosphatase.
7. Determination of Serum Alkaline phosphatase.
8. Determination of Serum Lactate dehydrogenase.
9. Determination of T3, T4 and TSH

Suggested Readings:

1. Medical laboratory Technology by KL Mukherjee Volume-III
2. Clinical Biochemistry by Richard Luxton
3. Basic Medical Laboratory techniques by Barbara H. Estridge et.al

B.Sc Medical Laboratory Science
Sixth Semester

BMLS-601

Unit-I

1. Introduction:- Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness. 2
2. Natural Resources:- Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources. 4
3. Ecosystems:-Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity 4

Unit-II

4. 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. 4
5. 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 4

Unit-III

6. 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. 6

Unit-IV

7. Understanding the Hospital Environment 1
8. Understanding the environment in the following clinical laboratories: 4
 - a. Microbiology
 - b. Biochemistry
 - c. Histopathology
 - d. Haematology
9. Clinical laboratory hazards to the environment from the following and means to prevent: 4
 - a. Infectious material
 - b. Toxic Chemicals
 - c. Radioactive Material
 - d. Other miscellaneous wastes

BMLS-602

The will be three months professional training.

Course	Course Name
BMLS-602	Professional Training (Three Months)
BMLS-604	Practical Evaluation -Project/Practical file -Practical (Performance) and viva

Environmental Sciences Practical

BMLS-603

1. Any Activity related to the public awareness about the environment:
 - a. Preparation of Charts/Models
 - b. Visit to any effluent treatment plant
 - c. Seeding a plant/s and take care of it/them.
2. Preparation of models/charts in relation to natural resources of drinking water.
3. Preparation of Models of Ecosystem on biodiversity.
4. Effects of environmental pollution on humans through poster presentation.
5. Any Activity related to wild life preservation.
6. Visit to any hospital/ clinical laboratory and understanding the environment therein.
7. Any activity related biomedical waste management in a hospital or clinical laboratory

Suggested Readings

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.

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5. Principle of Environment Science by Cunningham, W.P.
6. Essentials of Environment Science by Joseph.
7. Environment Pollution Control Engg. By Rao, C.S.
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10. Elements of environment engg. By Duggal.