

**NAGALAND UNIVERSITY**

**Regulation and Syllabus for**

**Bachelors in Medical Laboratory Science**

**(BMLS)**

**(3 ½ years + 6 months) Degree course**

**2024**

## **Regulations for the Allied Health Sciences Bachelor Programs of the Nagaland University**

*The Regulations & syllabus are subject to modifications by the University from time to time.*

### **1. Eligibility for Admission:**

- (i) The candidate should have passed the Higher Secondary (10+2) from CBSE or State Education Board or any Govt. recognized Board with at least 50% marks for general candidates (UR) and 45% for SC/ST/OBC/NCL candidates in Physics, Chemistry, and Biology.
- (ii) For B.Sc. (Health Information Management) course, candidates with Physics, Chemistry, and Mathematics in 10+2 may also be considered.
- (iii) The candidate should have attained the minimum age of 17 years during the admission.
- (iv) **Lateral Entry:**

Candidates who have completed a two-year diploma programme in the concerned subject from Boards recognized by Central / State Government(s) / State / Central University with at least 50% marks in aggregate for (UR) candidates and 45% marks in aggregate for SC / ST / OBC / NCL candidates shall be eligible for Lateral Entry to the second year (3<sup>rd</sup> Semester) of Bachelor Programme in Allied Health Sciences.

### **2. Duration of the Course:**

- (i) Group A: 4 years, i.e., 3 years or 6 semesters of academic studies and one year of internship (B.Sc.HIM, B.Sc.DTT, B.Sc.AOTT, BSc RTT, BSc. MRIT).  
Group B: 4 and a half years, i.e., 4 years or 8 semesters of academic studies and six months of internship (BPT, BOT courses).  
Group C: 4 years, i.e., 3 and a half year or 7 Semesters of academic studies and six months of internship (BMLS) during the 8<sup>th</sup> semester.
- (ii) The maximum duration of the Bachelor Programme for Group A, B & C above shall be N+2 where N is the normal duration of the programme. No student shall be allowed to continue beyond the maximum duration.

### **3. Medium of Instruction:**

The medium of instruction for all the Allied Health Sciences courses shall be English.

### **4. Working Days Per Semester:**

Each Semester consists of 90 working days, with eight hours of work per day and 40 hours per week, totalling 720 hours per Semester.

## 5. Internship Hours:

One-year Internship programs will include 1440 hours of practical training and Six Months Internship will include 720 hours of practical training.

## 6. Attendance:

- (i) A candidate must secure a minimum of 80% attendance in theory classes. Students who fail to meet the requirement due to illness may be eligible for a 5% condonation, provided they submit a medical certificate from a registered medical practitioner.
- (ii) 100% in skills training (practical/internship) to qualify for the award of degree. In case of insufficient attendance, the candidate's internship period will be extended accordingly. There are no other exceptions to these rules under any circumstances.

## 7. Submission of Log Books:

- a. At the time of practical examination, each candidate shall submit to the examiners his / her Log book duly certified by the Head of the Department as a bonafide record of the work done by the candidate.
- b. The practical record shall be evaluated by the concerned Head of the Department (Internal Evaluator) and the practical record marks shall be submitted to the University 15 days prior to the commencement of the theory Examinations.
- c. In respect of failed candidates, the marks awarded for record at previous examination will be carried over for the subsequent examination. The candidates shall have the option to improve his performance by submission of fresh records.

## 8. Revaluation / Scrutiny of Answer Papers:

- (i) There is no provision for candidate to request for revaluation of the answer papers of failed candidates in any examination. However, the failed candidates can apply for scrutiny.
- (ii) Nagaland University shall constitute a Result Moderation Committee of 3 members.

## 9. Pattern of Question Paper for University Examination:

Descriptive type Questions	=30%
Descriptive Short Notes	=30%
Short Answer questions	=20%
MCQ Type	=20%

## 10. Assessment:

- (i) Assessment for theory and practical examinations: - Students must attain at least 50% marks in each theory and practical component, both in internal assessments and in the final University examinations to pass the course. The final marks will be 75% from the University examination and 25% will be from the internal assessment.
- (ii) The distribution of marks between theory and practical shall be provided in the **Curriculum and Syllabi** of each course.
- (iii) Assessment for internship: - During the internship, students gain clinical experience and learn to document patient care effectively. Each student must maintain a logbook and a portfolio.

Activity	Marks %	Assessor
Log book	20	Supervisor
Portfolio*	20	Supervisor
Practical	40	Examiners
Viva voce	20	Examiners

\*The portfolio provides one with an opportunity to demonstrate the breadth and depth of your knowledge on certain topics

The portfolio incorporates the follow documents:

- Curriculum vitae
- Progress reports
- “Summary of Competency Achievement” demonstrating the level of competency achieved in each sub-module.
- Samples of work prepared by the intern from at least 5 of the modules of internship training guide.

A presentation delivered covering key aspects of the module

The clinical supervisor will examine the portfolio at regular (at least once in three months) intervals and provide feedback to the Intern.

(iv) Mode of Evaluation: -

Evaluation for Theory papers during Odd End Semester Examination shall be internally done by the colleges and Theory papers during Even End Semester Examinations shall be externally evaluated or as notified by the University.

#### **11. Internship Project:**

As part of the internship, students are required to choose a relevant subject and prepare an in-depth project report, which should include the objective, scope of the project, and a detailed report.

#### **12. Advancement to the Next Semester:**

Advancement to the next semester is contingent upon meeting the following conditions and clearing any backlogs as described: -

A student may not fail in more than two papers in the preceding semester to be eligible to advance to the next semester.

#### **13. Repeat examination for failed candidates:**

Failed papers in odd semesters can be repeated during the exams of the subsequent odd semester. Similarly, failed papers in even semesters exams can be repeated during the subsequent even semester exams.

#### **14. Vacation:**

Maximum of 15 days including Saturdays and Sundays

#### **15. Re-Admission after Break of Study:**

Students shall be allowed to continue after break in studies provided the maximum duration as given in Clause- 2 (ii) is not exceeded.

**16. Award of the Degree:**

- a. Candidates who have passed all written examinations and successfully completed the compulsory internship as per the university's requirements will be awarded the degree.
- b. Final Consolidated Mark sheet shall be issued by the Nagaland University to the candidate after submission of his/her Internship Completion Certificate by the College.

**17. Academic Calendar:**

- a. Odd semester shall be from July to December, and Even semester shall be from January to June.
- b. The odd semester and even semester university (end) examinations shall be conducted in the months of December and June respectively.

XXXXXXXXXX

### First Semester – Foundation Course

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-101	Paper I • Principles of Management and Orientation to Medical Laboratory Science • Quality and Patient safety	72	36	25	25	75	75	200	3	2	5
BMLS-102	Paper II • Community orientation and clinical visit • Environmental Science	72	36	25	25	75	75	200	3	2	5
BMLS-103	Paper III • Medical Terminology • Medical Law and Ethics	72	-	25	-	75	-	100	3		3
BMLS-104	Paper IV • Basic computers and information science • Introduction to National Healthcare Delivery System in India	72	36	25	25	75	75	200	4	1	5
BMLS-105	Paper V • Communication and soft skills • Professionalism and values	72	-	25	-	75	-	100	2		2
	<b>TOTAL</b>	Total contact hours- 468						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical

### Second Semester

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-201	General Clinical Microbiology	72	54	25	25	75	75	200	3	2	5
BMLS-202	Basic Haematology	72	54	25	25	75	75	200	3	2	5
BMLS-203	Basic Clinical Biochemistry	72	54	25	25	75	75	200	3	2	5
BMLS-204	Human Anatomy and Physiology	72	54	25	25	75	75	200	3	2	5
	<b>TOTAL</b>	Total contact hours- 504						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical

**Third Semester**

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-301	Systematic Bacteriology	72	54	25	25	75	75	200	3	2	5
BMLS-302	Basics of Haematological diseases	72	54	25	25	75	75	200	3	2	5
BMLS-303	Biochemical metabolism	72	54	25	25	75	75	200	3	2	5
BMLS-304	Fundamentals of Histology	72	54	25	25	75	75	200	3	2	5
	<b>TOTAL</b>	Total contact hours- 504						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical

**Fourth Semester**

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-401	Applied Bacteriology	72	54	25	25	75	75	200	3	2	5
BMLS-402	Applied Haematology – I	72	54	25	25	75	75	200	3	2	5
BMLS-403	Analytical Clinical Biochemistry	72	54	25	25	75	75	200	3	2	5
BMLS-404	Applied Histopathology – I	72	54	25	25	75	75	200	3	2	5
	<b>TOTAL</b>	Total contact hours- 504						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical
2. Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

### Fifth Semester

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-501	Immunology & Bacterial serology	72	54	25	25	75	75	200	3	2	5
BMLS-502	Applied Haematology – II	72	54	25	25	75	75	200	3	2	5
BMLS-503	Applied Clinical Biochemistry – I	72	54	25	25	75	75	200	3	2	5
BMLS-504	Applied Histopathology – II	72	54	25	25	75	75	200	3	2	5
<b>TOTAL</b>		Total contact hours- 504						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical
2. Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

### Sixth Semester

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-601	Medical Parasitology & Entomology	72	54	25	25	75	75	200	3	2	5
BMLS-602	Advanced Haematology	72	54	25	25	75	75	200	3	2	5
BMLS-603	Applied Clinical Biochemistry – II	72	54	25	25	75	75	200	3	2	5
BMLS-604	Cytopathology	72	54	25	25	75	75	200	3	2	5
<b>TOTAL</b>		Total contact hours- 504						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical
2. Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)



### Seventh Semester

Subject Code	Course Titles	Contact Hours		Internal Marks		Semester Marks		Total Marks	Credits		Total Credits
		T	P	T	P	T	P		T	P	
BMLS-701	Medical Mycology and Virology	72	54	25	25	75	75	200	3	2	5
BMLS-702	Blood Banking & Genetics	72	54	25	25	75	75	200	3	2	5
BMLS-703	Immunopathology & Molecular Biology	72	54	25	25	75	75	200	3	2	5
BMLS-704	Research methodology and Biostatistics	72	54	25	25	75	75	200	3	2	5
	<b>TOTAL</b>	Total contact hours- 504						800			20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical
2. Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

### Eighth Semester

Subject Code	Course Titles	Contact Hours	Total Marks	Total Credits
		P	P	
BMLS-801	MLS Internship	720	100	20
	<b>TOTAL</b>	720	100	20

**NOTE:**

1. Abbreviations: L - Lecture, T - Tutorials and P – Practical

**INTERNSHIP** – After completion of seven semesters of Bachelor MLS the candidates shall undergo six-months internship in a Government recognized hospital/Institution as partial fulfillment for the award of Bachelor in MLS as per government norms.

## **BMLS-101: Paper I**

### **a. Principals of Management with special reference to Medical Laboratory Science (MLS) Management and Orientation to Medical Laboratory Science:**

#### **Medical Laboratory Science Management**

The course is intended to provide knowledge about the basic principles of Management listed below, in addition to MLS management:

#### **Medical Laboratory Science Management**

##### **Rationale:**

The students will be made aware of the basic ethics, good lab practices including awareness/safety in a clinical lab. In addition, they will understand sample accountability, quality management system, biomedical waste management, calibration and validation of clinical laboratory instruments, Laboratory Information system (LIS), Hospital Information system (HIS) and financial management.

1. Ethical Principles and standards for a clinical laboratory professional
  - 1.1 Duty to the patient
  - 1.2 Duty to colleagues and other professionals
  - 1.3 Duty to the society
2. Good Laboratory Practice (GLP) Regulations and Accreditation
  - 2.1 Introduction to Basics of GLP and Accreditation
  - 2.2 Aims of GLP and Accreditation
  - 2.3 Advantages of Accreditation
  - 2.4 Brief knowledge about National and International Agencies for clinical laboratory accreditation
3. Awareness / Safety in a clinical laboratory
  - 3.1 General safety precautions
  - 3.2 HIV: pre- and post-exposure guidelines
  - 3.3 Hepatitis B & C: pre- and post-exposure guidelines
  - 3.4 Drug Resistant Tuberculosis
4. Patient management for clinical samples collection, transportation and preservation
5. Sample accountability
  - 5.1 Purpose of accountability
  - 5.2 Methods of accountability
6. Sample analysis
  - 6.1 Introduction
  - 6.2 Factors affecting sample analysis
  - 6.3 Reporting results
  - 6.4 Basic format of a test report
  - 6.5 Reported reference range
  - 6.6 Clinical Alerts
  - 6.7 Abnormal results
  - 6.8 Turnaround time
  - 6.9 Results from referral laboratories
  - 6.10 Release of examination results
  - 6.11 Alteration in reports

7. Quality Management system
  - 7.1 Introduction
  - 7.2 Quality assurance
  - 7.3 Quality control system
  - 7.4 Internal and External quality control
8. Biomedical waste management in a clinical laboratory
9. Introduction and importance of calibration and Validation of Clinical Laboratory instruments
10. Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management
  - 10.1 Introduction
  - 10.2 Functions of a laboratory management system
  - 10.3 Standards for laboratory management system
  - 10.4 Introduction and awareness of financial management in a clinical laboratory
11. Ethics in Medical Laboratory Practice
  - 11.1 Understanding the term 'Ethics'
  - 11.2 Ethics in relation to the following:
    - 11.2.1 Pre-Examination procedures
    - 11.2.2 Examination procedures
    - 11.2.3 Reporting of results
  - 11.3 Preserving medical records
  - 11.4 Access to Medical Laboratory Records
12. Procurement of equipment and Inventory Control
  - 12.1 Audit in a Medical Laboratory
  - 12.2 Introduction and Importance
  - 12.3 Responsibility
  - 12.4 Planning
  - 12.5 Horizontal, Vertical and Test audit
  - 12.6 Frequency of audit
  - 12.7 Documentation

### **Orientation to Medical Laboratory Science (MLS)**

**The students will be oriented to the role of medical laboratory professional in healthcare system, scope, purpose, career opportunities in Medical Laboratory science. They will also be introduced to healthcare system and public health in India.**

1. Medical Lab Science – Introduction
2. Career opportunities in MLS
3. Role of a Medical lab. professional in Health care system
4. Common laboratory associated hazards and biosafety measures including radiation hazards
5. Subject specific role of a Medical lab. professional:
6. Microbiology
  - 6.1. Role of microbes in human health
  - 6.2. Overview of the role of Medical Laboratory Professional in Medical Microbiology
  - 6.3. Bio-safety in Microbiology
7. Haematology
  - 7.1. Introduction to Haematological diseases
  - 7.2. Overview of the role of Medical lab. professional in Haematology

- 7.3. Bio-safety in Haematology
- 8. Histopathology
  - 8.1. Introduction to Tumor pathology
  - 8.2. Overview of the role of Medical lab. professional in Histopathology
  - 8.3. Bio-safety in Histopathology
- 9. Biochemistry
  - 9.1. Introduction to metabolic disorders
  - 9.2. Overview of the role of Medical lab. professional in Clinical Biochemistry
  - 9.3. Bio-safety in Clinical Biochemistry

**Suggested readings:**

1. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur
2. An Introduction to Medical Lab Technology by F J Baker and Silverton

**b. Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)**

**Rationale:** The subject will introduce the students to the basic concepts of quality in health care and develop skills to implement sustainable quality assurance program in the health system. It will sensitize them in basic emergency care, infection prevention & control with knowledge of bio-medical waste management and antibiotic resistance.

1. Quality assurance and management - The objective of the subject is to help students understand the basic concepts of quality in health care and develop skills to implement sustainable quality assurance program in the health system.
  - 1.1 Concepts of Quality of Care
  - 1.2 Quality Improvement Approaches
  - 1.3 Standards and Norms
  - 1.4 Quality Improvement Tools
  - 1.5 Introduction to NABH guidelines
2. Basics of emergency care and life support skills – Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:
  - 2.1 Vital signs and primary assessment
  - 2.2 Basic emergency care – first aid and triage

- 2.3 Ventilations including use of bag-valve-masks (BVMs)
- 2.4 Choking, rescue breathing methods
- 2.5 One- and Two-rescuer CPR
- 2.6 Using an AED (Automated external defibrillator).
- 2.7 Managing an emergency including moving a patient

At the end of this topic, the students should be able to perform the maneuvers in a simulation lab and test their skills focusing on airway management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

- 3. Bio medical waste management and environment safety – The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:
  - 3.1 Definition of Biomedical Waste
  - 3.2 Waste minimization
  - 3.3 BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
  - 3.4 Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
  - 3.5 BMW Management & methods of disinfection
  - 3.6 Modern Technology for handling BMW
  - 3.7 Use of Personal protective equipment (PPE)
  - 3.8 Monitoring & controlling of cross infection (Protective devices)
- 4. Infection prevention and control – The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –
  - 4.1 Evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)],
  - 4.2 Prevention & control of common healthcare associated infections,
  - 4.3 Components of an effective infection control program, and
  - 4.4 Guidelines (NABH and JCI) for Hospital Infection Control
- 5. Antibiotic Resistance-
  - 5.1 History of antibiotics
  - 5.2 How resistance happens and spreads
  - 5.3 Types of resistance- intrinsic, acquired, passive
  - 5.4 Trends in drug resistance
  - 5.5 Actions to fight resistance
  - 5.6 Bacterial persistence
  - 5.7 Antibiotic sensitivity
  - 5.8 Consequences of antibiotic resistance
  - 5.9 Antimicrobial Stewardship – Barriers and opportunities, tools and models in hospitals
- 6. Disaster preparedness and management – The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-
  - 6.1 Fundamentals of emergency management,
  - 6.2 Psychological impact management,
  - 6.3 Resource management,
  - 6.4 Preparedness and risk reduction,
  - 6.5 Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and

institutional mechanisms.

**Suggested readings:**

1. The Essentials of Patient Safety by Charles Vincent
2. Laboratory quality control and patient safety by De Gruyter

**BMLS-101 (Practical)**

**Principals of Management with special reference to Medical Laboratory Science (MLS)  
Management**

1. Clinical sample collection e.g.
  - 1.1 Blood
  - 1.2 Urine
  - 1.3 Stool
  - 1.4 Saliva
  - 1.5 Sputum
  - 1.6 Semen analysis
2. Sample accountability
  - 2.1 Labeling of sample
  - 2.2 Making entries in Laboratory records
3. Reporting results
  - 3.1 Basic format of a test report
  - 3.2 Release of examination results
  - 3.3 Alteration in reports
4. Quality Management system
  - 4.1 Quality assurance
  - 4.2 Internal and External quality control
  - 4.3 Quality improvement
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:
  - 7.1 Pre-Examination procedures
  - 7.2 Examination procedures
  - 7.3 Reporting of results
  - 7.4 Preserving medical records
  - 7.5 Access to medical laboratory records
8. Audit in a Medical Laboratory –Documentation
9. Sensitization on career opportunities and role of MLS in Hospital Care
10. Visit to working;
  - 10.1 Microbiology
  - 10.2 Haematology
  - 10.3 Biochemistry and
  - 10.4 Histopathology laboratories

**Quality and Patient safety:**

1. Discussion on Concepts of Quality of Care
2. Approaches to Quality Improvement
3. Quality Improvement Tools
4. Discussion on NABH guidelines and its exercises

**Basics of emergency care and life support skills:**

1. Vital signs and primary assessment
2. Basic emergency care – first aid and triage
3. Ventilations including use of bag-valve-masks (BVMs)
4. Choking, rescue breathing methods
5. One- and Two-rescuer CPR
6. Using an AED (Automated external defibrillator).
7. Managing an emergency including moving a patient

Students should perform the maneuvers in simulation lab and to test their skills with focus on airways management and chest compressions.

**Bio medical waste management and environment safety-**

1. Visit to Central Sterile Supply Department (CSSD)
2. Visit to incinerator complex
3. Visit to Immunization section
4. Discussion on Biomedical Waste,
5. Demonstration of Types of waste generated from Health Care Facility
6. Discussion on waste minimization
7. Poster presentation of BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
8. Discussion on Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
9. Visit to Central Sterile Supply Department for demonstration of BMW Management & methods of disinfection
10. Modern Technology for handling BMW e.g. Incinerator, Shredder etc.
11. Demonstration of proper use of Personal protective equipment (PPE)
12. Demonstration of monitoring & controlling of cross infection (Protective devices)

**Infection prevention and control:**

1. Demonstration of evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)],
2. Discussion on prevention & control of common healthcare associated infections,
3. Preparing Charts & Posters of Components of an effective infection control program, and
4. Guidelines (NABH and JCI) for Hospital Infection Control

**Antibiotic Resistance-**

1. Discussion on various types of Antibiotics
2. Demonstration of how Resistance Happens and Spreads
3. Discussion on types of resistance- Intrinsic, Acquired, Passive
4. Antibiotic sensitivity testing
5. Display of Consequences of antibiotic resistance
6. Demonstration of Antimicrobial Barriers and opportunities, Tools and models in hospitals

**Disaster preparedness and management:**

1. Discussion on fundamentals of emergency management,
2. Management psychological impact
3. Discussion on;
  - 3.1 Resource management,
  - 3.2 Preparedness and risk reduction

## **BMLS-102: Paper II**

### **a. Community Orientation and Clinical Visit**

1. The community orientation and clinical visit will include visit to the entire chain of the healthcare delivery system – Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics.
2. The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front line health workers.
3. Clinical visit to their respective professional department within the hospital.

### **b. Environmental Science**

#### **Rationale:**

The student will be made aware of the environment in general, natural resources, ecosystems, environmental pollution, and social issues related to environment, human population and the environment and understanding the hospital environment.

1. Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.
2. Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.
3. Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hotspots of biodiversity
4. Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards
  - 4.1 Solid waste management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.
  - 4.2 Disaster management: Floods, earthquake, cyclone and landslides.
5. Social blemishes and the Environment from Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, water shed management Resettlement and rehabilitation of people; its pros and concerns.
  - 5.1 Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
  - 5.2 Case studies, Wasteland reclamation.
  - 5.3 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.
  - 5.4 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. Understanding the Hospital Environment
7. Understanding the environment in the following clinical laboratories:
  - 7.1 Microbiology
  - 7.2 Biochemistry
  - 7.3 Histopathology
  - 7.4 Haematology
8. Clinical laboratory hazards to the environment from the following and means to prevent:
  - 8.1 Infectious material
  - 8.2 Toxic Chemicals



- 8.3 Radioactive Material
- 8.4 Other miscellaneous wastes

### **Suggested Readings**

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.
2. Jadhav, H & Bhosale, V.M. 1995. Environment Protection and Laws. Himalaya Pub House, Delhi 284 p.
3. Rao M. N. & Datta A.K. 1987. Waste water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
4. Daniel D. Chiras 2010. Environmental Science. 1st Indian Edition, Jones and Bartlett India Pvt. Ltd. 4262/3, Ansar Road, Daryaganj, New Delhi.
5. Principle of Environment Science by Cunningham, W.P.
6. Essentials of Environment Science by Joseph.
7. Environment Pollution Control Engineering by Rao, C.S.
8. Perspectives in Environmental Studies by Kaushik, A.
9. Elements of Environment Science & Eng. By Meenakshi.
10. Elements of environment Eng. by Duggal.

### **BMLS-102: (Practical)**

1. Any Activity related to the public awareness about the environment:
  - 1.1 Preparation of Charts/Models
  - 1.2 Visit to any effluent treatment plant
  - 1.3 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

### **BMLS-103: Paper III**

#### **a. Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)**

**Rationale:** This subject introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests.

#### **Topics to be covered under the subject are as follows:**

##### **Medical Terminology, Record keeping**

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.

6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

**Suggested readings:**

1. An Introduction to Medical Lab Technology by F J Baker and Silverton
2. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur

**b. Medical Law and Ethics**

**Rationale:** Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical science, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.

Medical ethics has developed into a well-based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Physicians are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to be focused on are as follows:

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality
4. Malpractice and negligence - Rational and irrational drug therapy
5. Autonomy and informed consent - Right of patients
6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
9. Professional Indemnity insurance policy
10. Development of standardized protocol to avoid near miss or sentinel events
11. Obtaining an informed consent.
12. Ethics in the profession of Medical Laboratory Science

**Suggested readings:**

1. Medical Law and Ethics by Bonnie F Fremgen
2. Medical Law and Ethics by Jonathan Herring

## **BMLS-104: Paper IV**

### **a. Basic computers and information science**

**Rationale:** The students will be able to appreciate the role of computer technology. The course focuses on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.
2. 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).
3. Processor and memory: The Central Processing Unit (CPU), main memory.
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.
5. 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.).
6. 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.
7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
9. Introduction of Operating System: introduction, operating system concepts, types of operating system
10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
11. 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.
12. Application of Computers in clinical settings.

#### **Suggested Readings:**

1. Information technology by Anshuman Sharma (Lakhanpal Publisher)
2. Computer Fundamentals (Concepts. Systems and applications) by P. K. Sinha (University of Tokyo, Japan) BPB Publications

### **b. Introduction to National Healthcare Delivery System in India**

**Rationale:** The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to

be covered under the subject are as follows:

1. Introduction to healthcare delivery system
  - 1.1. Healthcare delivery system in India at primary, secondary and tertiary care
  - 1.2. Community participation in healthcare delivery system
  - 1.3. Health system in developed countries.
  - 1.4. Private Sector
  - 1.5. National Health Mission
  - 1.6. National Health Policy
  - 1.7. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Health Programme.
3. Introduction to AYUSH system of medicine
  - 3.1. Introduction to Ayurveda.
  - 3.2. Yoga and Naturopathy
  - 3.3. Unani
  - 3.4. Siddha
  - 3.5. Homeopathy
  - 3.6. Need for integration of various system of medicine
4. Health scenario of India – past, present and future, Public health – India (epidemiology and demography)
5. Demography & Vital Statistics-
  - 5.1. Demography – its concept
  - 5.2. Vital events of life & its impact on demography
  - 5.3. Significance and recording of vital statistics
  - 5.4. Census & its impact on health policy
6. Epidemiology
  - 6.1. Principles of Epidemiology
  - 6.2. Natural History of disease
  - 6.3. Methods of Epidemiological studies
  - 6.4. Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

## **BMLS-104 Practical**

### **Basic computers and Information Science**

Practical on fundamentals of computers -

1. Demonstration of basic hardware of the computers and laptops
2. Learning to use MS office: MS word, MS PowerPoint, MS Excel
3. To install different software
4. Data entry efficiency

## **BMLS-105: Paper V**

### **a. Communication and soft skills**

**Rationale:** The students will be able to appreciate communication skills as these are important to everyone - they are how we give and receive information and convey our ideas and opinions with those around us.

**Soft skills** is a term often associated with a person's "EQ" (Emotional Intelligence Quotient), which is the cluster of personality traits that characterize one's relationships with other people. These skills can include social graces, communication abilities, language skills, personal habits, cognitive or emotional empathy, and leadership traits.

A person's soft skill EQ is an important part of their individual contribution to the success of an organization. Organizations which deal with customers face-to-face are generally more successful if they train their staff to use these skills. Screening or training for personal habits or traits such as dependability and conscientiousness can yield significant return on investment for an organization. For this reason, soft skills are increasingly sought out by employers in addition to standard qualifications.

Topics taught in this module include:

1. Basic Language Skills: Grammar and Usage.
2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.
3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome

**Soft Skills** - with important sub-elements:

1. Communication Styles
2. Team work
3. Leadership Skills
4. Effective & Excellent Customer Service
5. Decision Making & Problem Solving
6. Managing Time and Pressures
7. Self-Management & Attitude

**Suggested readings:**

1. Effective Communication and Soft Skills by Nitin Bhatnagar Pearson Education India, 2011
2. Communication N Soft Skills Paperback – 2014 by Niraj Kumar, Chetan Srivastava

## b. Professionalism and Values

**Rationale:** This module will deliver the concepts of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how professionalism is relevant in terms of the healthcare system and how it affects the overall patient environment.

1. Professional values – Integrity, Objectivity, Professional competence and due care, confidentiality
2. Personal values – ethical or moral values
3. Attitude and behavior – professional behavior, treating people equally
4. Code of conduct, professional accountability and responsibility, misconduct
5. Differences between professions and importance of team efforts
6. Cultural issues in the healthcare environment

### Suggested Readings

1. R. R. Gaur, R. Sangal, G.P. Bagaria, 2009, a Foundation Course in Value Education.
2. E.F. Schumacher, 1973, Small is Beautiful: A study of Economics as if people mattered, Blond & Briggs, Britain.
3. A. Nagraj, 1998, Jeevan Vidyaek Parichay, Divya Path Sansthan, Amarkantak.
4. P.L Dhar, R.R.Gaur, 1990, Science and Humanism, Common wealth Publishers.
5. A.N. Tripathy, 2003, Human Values, New Age International Publishers
6. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
7. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.

## *Second Semester*

### **BMLS-201: General Medical Microbiology**

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

1. Introduction to Medical Microbiology:
  - 1.1 Definition
  - 1.2 History
  - 1.3 Host - Microbe relationship
2. Safety measures in Clinical Microbiology
3. Glassware used in Clinical Microbiology Laboratory:
  - 3.1 Introduction
  - 3.2 Care and handling of glassware
  - 3.3 Cleaning of glassware
  - 3.4 Equipment used in clinical Microbiology Laboratory:
    - 3.4.1 Introduction
    - 3.4.2 Care and maintenance including calibration
4. Microscopy
  - 4.1 Introduction and history
  - 4.2 Types, principle and operation mechanism of following microscopes
    - 4.2.1 Light microscope

- 4.2.2 DGI
- 4.2.3 Fluorescent
- 4.2.4 Phase contrast
- 4.2.5 Electron microscope: Transmission/ Scanning
- 5. Sterilization:
  - 5.1 Definition
  - 5.2 Types and principles of sterilization methods
    - 5.2.1 Heat (dry heat, moist heat with special Reference to autoclave)
    - 5.2.2 Radiation
    - 5.2.3 Filtration
    - 5.2.4 Efficiency testing to various sterilizers
- 6. Antiseptics and disinfectants:
  - 6.1 Definition.
  - 6.2 Types and properties
  - 6.3 Mode of action - Uses of various disinfectants
  - 6.4 Precautions while using the disinfectants - Qualities of a good disinfectant
  - 6.5 Testing efficiency of various disinfectants
- 7. Biomedical waste management in a Medical Microbiology laboratory:
  - 7.1 Types of the waste generated – Segregation – Treatment – Disposal
- 8. General characteristics & classification of Microbes: (Bacteria & fungi)
  - 8.1 Classification of microbes with special reference to prokaryotes & eukaryotes
  - 8.2 Morphological classification of bacteria
  - 8.3 Bacterial anatomy (Bacterial cell structures)
- 9. Growth and Nutrition of Microbes:
  - 9.1 General nutritional & other requirements of the bacteria
  - 9.2 Classification of bacteria on the basis of their nutritional requirements
  - 9.3 Physical conditions required for growth.
  - 9.4 Normal growth cycle of bacteria (growth curve)
  - 9.5 Types of microbial cultures: Synchronous, Static, continuous culture.
- 10. Culture media:
  - 10.1 Introduction
  - 10.2 Classification of culture media (Example & 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
  - 10.3 Quality control in culture media
  - 10.4 Automation in culture media preparation
- 11. Aerobic & anaerobic culture methods:
  - 11.1 Concepts
  - 11.2 Methods Used for aerobic cultures
  - 11.3 Methods used for anaerobic cultures
- 12. Introductions to Immunology
  - 12.1 Immunity
  - 12.2 Antigens and Antibodies
- 13. Care & handling of laboratory animals:
  - 13.1 Introduction
  - 13.2 General care & handling
  - 13.3 Ethics & legality in use of laboratory animals

## Suggested Readings

1. Practical Medical Microbiology by Mackie and McCartney
2. Text book of Microbiology by Ananthanarayan
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 Monica Cheesbrough
6. Text book of Microbiology by Prescott

## BMLS-201: General Medical Microbiology – Practical

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 including its efficacy testing.
5. To demonstrate the method of sterilization by hot air oven including its efficacy testing.
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. Kelsey-Sykes test
14. To demonstrate the different morphological types of bacteria
15. Preparation of one culture media from each type
16. To demonstrate aerobic culture
17. To demonstrate anaerobic culture
18. Visit to animal house & demonstrate about care of laboratory animals

## BMLS-202: Basic Haematology

**Rationale:** Students will be made aware of the composition of blood and methods of estimating different components of blood. Students will learn the basic concepts of Haematology & routine clinical investigations of Haematology laboratory.

1. Introduction to Haematology
  - 1.1 Definition
  - 1.2 Importance
  - 1.3 Important equipment used
2. Laboratory organization and safety measures in Haematology Laboratory
3. Introduction to blood, its composition, function and normal cellular components
4. Anticoagulants: types, mode of action and preference of anticoagulants for different hematological studies
5. Collection and preservation of blood sample for various hematological investigations
6. Formation of cellular components of blood (Haemopoiesis)
  - 6.1 Erythropoiesis
  - 6.2 Leucopoiesis
  - 6.3 Thrombopoiesis
7. Hemoglobin: definition, types, structure, synthesis and degradation
8. Morphology of normal blood cells



9. Normal Hemostasis & physiological properties of coagulation factors
10. Radioactivity: definition, half-life, physical decay and units
11. Urine analysis
12. Quality assurance in Haematology
  - 12.1 Internal and external quality control including reference preparation
  - 12.2 Routine quality assurance protocol
  - 12.3 Statistical analysis i.e. Standard deviation, Co-efficient of variation, accuracy and precision

### **Suggested Readings**

1. Text book of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. Practical Haematology by J.B. Dacie
4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's Clinical Haematology in Medical Practice

### **BMLS-202 Basic Haematology – Practical**

1. Preparation of various anticoagulants:
  - 1.1 EDTA
  - 1.2 Sodium Citrate,
  - 1.3 Oxalate with Fluoride
2. Collection of blood sample for various Lab Investigations
3. Familiarization and working of routine Haematology Lab. Instruments
  - 3.1 Microscopes
  - 3.2 Haemocytometers
  - 3.3 Colorimeter
  - 3.4 Spectrophotometer
  - 3.5 Glass pipettes & Auto pipettes
  - 3.6 Glassware
  - 3.7 Sahli's Apparatus
4. Identification of Normal blood cells
5. Urine Analysis:
  - 5.1 Routine biochemistry of Urine for:
    - 5.1.1 pH
    - 5.1.2 Specific Gravity
    - 5.1.3 Glucose
    - 5.1.4 Ketones
    - 5.1.5 Bilirubin
    - 5.1.6 Albumin
    - 5.1.7 Microscopic Examination of Urine

### **BMLS-203 Basic Clinical Biochemistry**

**Rationale:** The main objective of the subject is to impart the knowledge of apparatus, units, equipment, and volumetric analysis in the laboratory of clinical Biochemistry.

1. Introduction to Medical lab. Technology
  - 1.1 Role of Medical Lab Technologist
  - 1.2 Ethics and responsibility
  - 1.3 Safety measures
  - 1.4 First aid

2. Cleaning and care of general laboratory glass ware and equipment
  - 2.1 Steps involved in cleaning soda lime glass
  - 2.2 Steps involved in cleaning borosil glass
  - 2.3 Preparation of chromic acid solution
  - 2.4 Storage
3. Distilled water
  - 3.1 Method of preparation of distilled water
  - 3.2 Type of water distillation plants
  - 3.3 Storage of distilled water
4. Units of Measurement.
  - 4.1 S.I unit and CGS units
  - 4.2 Conversion
  - 4.3 Strength, molecular weight, equivalent weight
  - 4.4 Normality, Molarity, Molality
  - 4.5 Numerical
5. Calibration of volumetric apparatus
  - 5.1 Flask
  - 5.2 Pipettes
  - 5.3 Burettes
  - 5.4 Cylinders
6. Analytical balance
  - 6.1 Principle
  - 6.2 Working
  - 6.3 Maintenance
7. Concept of pH
  - 7.1 Definition
  - 7.2 Henderson Hassel batch equation
  - 7.3 Pka value
  - 7.4 pH indicator
  - 7.5 Methods of measurement of pH
    - 7.5.1 pH paper
    - 7.5.2 pH meter
    - 7.5.3 Principle, working, maintenance and calibration of pH meter
8. Volumetric analysis
  - 8.1 Normal and molar solutions
  - 8.2 Standard solutions
  - 8.3 Preparation of reagents
  - 8.4 Storage of chemicals
9. Osmosis
  - 9.1 Definition
  - 9.2 Types of osmosis
  - 9.3 Factors affecting osmotic pressure
  - 9.4 Vant Hoff's equation
  - 9.5 Applications of osmosis
  - 9.6 Dialysis

### **Suggested Readings**

1. Text book of Medical Laboratory Technology by P. B. Godker
2. Medical Laboratory Technology by K.L. 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 Chatterjee, Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet & Voet
9. Biochemistry by Stryer

### **BMLS-203: Basic Clinical Biochemistry – Practical**

1. Cleaning of the laboratory glass ware (Volumetric and non-volumetric)
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<sub>2</sub>SO<sub>4</sub>
7. To prepare 0.2 Molar Sodium carbonate solution.
8. Demonstration of osmosis and dialysis.

### **BMLS-204: Human Anatomy and Physiology**

**Rationale:** 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.

1. Introduction to human Anatomy and Physiology
2. Cell and cell organelles
  - 2.1 Structure and classification
  - 2.2 Function
  - 2.3 Cell division (Mitosis and Meiosis)
3. Tissues
  - 3.1 Definition
  - 3.2 Classification with structure and Functions
    - 3.2.1 Epithelial tissues
    - 3.2.2 Connective tissues
    - 3.2.3 Muscular tissues
    - 3.2.4 Nervous tissue
4. Blood
  - 4.1 Composition
  - 4.2 Function of blood
5. Muscular skeletal system
  - 5.1 Introduction
  - 5.2 Classification
  - 5.3 Structure and function of skeletal system, muscles and joints
  - 5.4 Various movements of body
6. Respiratory system
  - 6.1 Introduction
  - 6.2 Structure
  - 6.3 Function
  - 6.4 Mechanism of breathing and respiration
  - 6.5 Various terms involved in respiratory System
    - 6.5.1 Vital capacity
    - 6.5.2 Total Volume
    - 6.5.3 Reserve volume

- 6.5.4 Total lung capacity
- 7. Cardiovascular system
  - 7.1 Anatomy and physiology of heart
  - 7.2 Blood circulation
  - 7.3 Arteries and veins
  - 7.4 Conductive system of heart
  - 7.5 Cardiac cycle
  - 7.6 Introduction to ECG
- 8. Lymphatic system
  - 8.1 Introduction
  - 8.2 Structure and function
    - 8.2.1 Lymph nodes
    - 8.2.2 Spleen
    - 8.2.3 Thymus gland, Tonsils
- 9. Structure and function of sense organ
  - 9.1 Eye
  - 9.2 Ear
  - 9.3 Nose
  - 9.4 Tongue
- 10. 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
- 11. Digestive system: Organization; accessory organs; structure & function (Mouth, Tongue, Teeth, Esophagus, Pharynx, Stomach, Intestine, Rectum, Anus); Digestive glands; physiology of digestion of carbohydrates, lipids & proteins
- 12. Liver: structure and function
- 13. Urinary system: Main parts, Structure & function of kidney, structure of nephron, physiology of excretion & urine formation, urine, additional excretory organs
- 14. Genital system: Structure of male and female reproductive system, Gametogenesis in male & female, menstrual cycle. Placenta and extra embryonic membranes.
- 15. Nervous system: Parts, function & structure; brain, spinal cord, spinal & cranial nerves; all & none principle, role of neurotransmitters in transmission of nerve impulse
- 16. Endocrine system: Endocrine & exocrine glands, their location, structure & functions

**Suggested readings:**

1. Anatomy & 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

**BMLS-204: Human Anatomy & Physiology – Practical**

1. Demonstration of various parts of body
2. Demonstration of tissues of body
3. Demonstration of parts of digestive system
4. Demonstration of parts of respiratory system
5. Demonstration of parts of skin
6. Demonstration of parts of excretory system

7. Demonstration of various parts of circulatory system (Demonstration from models)
8. Examination of blood film for various blood cells from stained slides
9. Blood pressure estimation
10. Demonstration of various parts of nervous system (brain and spinal cord) (Model)
11. Structure of eye and ear (demonstration from models)
12. Demonstration of reflex action
13. Demonstration of structural differences between skeletal, smooth and cardiac muscles (permanent mounts)
14. Demonstration of various bones and joints
15. Demonstration of various parts of reproductive system (Male and female from models and charts)
16. To study circulatory system from charts and transverse section (TS) of artery and vein from permanent slides.
17. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
18. Study of Urinary system (charts)
19. Study of Genital system (male & female) from charts and TS of testis and ovary from permanent slides.
20. To study nervous system (From models / charts)
21. To study various body fluids.

**Note:** Demonstrations can be done with the help of models, charts and histological slides

### *Third Semester*

#### **BMLS-301: Systematic Bacteriology**

**Rationale:** 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.

1. Bacterial culture
  - 1.1 Instruments used to seed culture media
  - 1.2 Culture procedures – seeding a plate
2. Staining techniques in bacteriology
  - 2.1 Significance of staining in bacteriology
  - 2.2 Principle, Reagent preparation, procedures and interpretation of the following
    - 2.2.1 Simple staining
    - 2.2.2 Negative staining
    - 2.2.3 Gram stain
    - 2.2.4 Albert's stain
    - 2.2.5 Neisser's stain
    - 2.2.6 Ziehl –Neelsen staining
    - 2.2.7 Capsule staining
    - 2.2.8 Flagella staining
    - 2.2.9 Spore staining
    - 2.2.10 Fontana stain for spirochetes
3. Principle, procedures and interpretation of the following biochemical tests for identification of different bacteria.
  - 3.1 Catalase
  - 3.2 Coagulase
  - 3.3 Indole

- 3.4 Methyl Red
- 3.5 Voges Proskauer
- 3.6 Urease
- 3.7 Citrate
- 3.8 Oxidase
- 3.9 TSIA
- 3.10 Nitrate reduction
- 3.11 Carbohydrate fermentation
- 3.12 Hage and Leifson
- 3.13 Bile solubility
- 3.14 H<sub>2</sub>S production
- 3.15 Demonstration of motility
- 3.16 Decarboxylases
- 3.17 CAMP
- 3.18 Hippurate hydrolysis
- 3.19 Naegler's reaction
- 3.20 Cholera-red reaction
- 4. Definition, Classification, Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the following bacteria
  - 4.1 Staphylococcus
  - 4.2 Streptococcus
  - 4.3 Pneumococcus
  - 4.4 Neisseria gonorrhoea and Neisseria meningitidis
  - 4.5 Haemophilus
  - 4.6 Corynebacterium
  - 4.7 Enterobacteriaceae: Escherichia coli, Klebsiella, Citrobacter, Enterobacter, Proteus, Salmonella, Shigella, Yersinia enterocolitica and Yersinia pestis
  - 4.8 Vibrio, Aeromonas and Plesiomonas
  - 4.9 Clostridia of wound infection
  - 4.10 Mycobacterium tuberculosis complex, Atypical Mycobacteria and M. leprae
  - 4.11 Spirochetes – Treponema, Borrelia and Leptospira
  - 4.12 Bordetella and Brucella
  - 4.13 Mycoplasma and Ureaplasma
  - 4.14 Rickettsia
  - 4.15 Chlamydia
  - 4.16 Actinomyces
  - 4.17 Pseudomonas and Burkholderia
  - 4.18 Brief introduction about non sporing anaerobic cocci and bacilli

#### **Suggested Readings:**

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
3. Medical Microbiology by Paniker & Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee

#### **BMLS-301: Systematic Bacteriology – 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, procedure and interpretation for
  - 6.1 Gram stain
  - 6.2 Albert stain
  - 6.3 Neisser's staining
  - 6.4 Z-N staining
  - 6.5 Capsule staining
  - 6.6 Demonstration of flagella by staining methods
  - 6.7 Spore staining
  - 6.8 To demonstrate spirochetes by Fontana staining procedure
7. To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria:
  - 7.1 Catalase
  - 7.2 Coagulase
  - 7.3 Indole
  - 7.4 Methyl Red (MR)
  - 7.5 Voges Proskauer (VP)
  - 7.6 Urease
  - 7.7 Citrate
  - 7.8 Oxidase
  - 7.9 TSIA
  - 7.10 Nitrate reduction
  - 7.11 Carbohydrate fermentation
  - 7.12 Huger and Leifson
  - 7.13 Bile solubility
  - 7.14 H<sub>2</sub>S production
  - 7.15 Demonstration and motility
  - 7.16 Decarboxylases
  - 7.17 CAMP
  - 7.18 Hippurate hydrolysis
  - 7.19 Naegler's reaction
8. To demonstrate various characteristics (morphological, cultural and biochemical) of bacteria commonly isolated from clinical samples i.e.
  - 8.1 Staphylococcus
  - 8.2 Streptococcus
  - 8.3 Corynebacterium
  - 8.4 Escherichia coli
  - 8.5 Klebsiella
  - 8.6 Citrobacter
  - 8.7 Enterobacter
  - 8.8 Proteus
  - 8.9 Salmonella
  - 8.10 Shigella
  - 8.11 Vibrio cholera
  - 8.12 Mycobacterium tuberculosis
  - 8.13 Pseudomonas

### **BMLS-302: Basics of Hematological Diseases**

**Rationale:** The students will be made aware of various diseases like anemia, quantitative disorders of Leucocytes, morphological alterations in blood cells, bleeding disorders.

1. Anemia
  - 1.1 Introduction
  - 1.2 Classification
    - 1.2.1 Microcytic hypochromic anemia
    - 1.2.2 Macrocytic anemia
    - 1.2.3 Normocytic normochromic anemia
2. Quantitative disorders of Leukocytes Cause and significance
  - 2.1 Granulocytic and Monocytic Disorders
  - 2.2 Lymphocytic Disorders
3. Morphologic Alterations in Neutrophils
  - 3.1 Toxic granulation
  - 3.2 Cytoplasmic vacuoles
  - 3.3 Döhle bodies
  - 3.4 May–Hegglin anomaly
  - 3.5 Alder–Reilly anomaly
  - 3.6 Pelger–Huët anomaly
  - 3.7 Chédiak–Higashi syndrome
4. Bleeding disorders
  - 4.1 Introduction Causes of bleeding disorders
  - 4.2 Vascular defect
    - 4.2.1 Platelet defect
    - 4.2.2 Factor deficiency
    - 4.2.3 Inhibitors
    - 4.2.4 Hyper fibrinolysis
  - 4.3 Types of bleeding disorders
    - 4.3.1 Inherited bleeding disorders
    - 4.3.2 Acquired bleeding disorders
5. Thrombosis
  - 5.1 Introduction
  - 5.2 Causes of thrombosis
6. Monitoring of Anticoagulants
  - 6.1 Oral anticoagulants by INR
  - 6.2 Heparin

### **Suggested Readings**

1. Textbook of Medical Laboratory Technology by Praful B. Godkar
2. Medical Laboratory Technology by K L Mukherjee Volume-I
3. Practical Haematology by J.B. Dacie
4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Haematology by G.A. McDonald
6. De Gruchy's clinical Haematology in medical practice
7. Wintrobe's Clinical Haematology– 2013 by John P. Greer, Daniel A. Arber, Bertil E. Glader, Alan F. List

### **BMLS-302: Basics of Haematological Diseases – Practical**

1. Parts of microscope; its functioning and care
2. Parts of centrifuge; its functioning and care
3. Cleaning and drying of glassware
4. Preparation of various anticoagulants
5. Collection of venous and capillary blood



6. Cleaning of glass-syringes and its sterilization
7. Preparation of the stains and other reagents
8. Preparation of peripheral blood film (PBF)
9. Staining of PBF
10. Haemoglobin estimation methods (Sahli's, Oxyhaemoglobin, and cyanmethaemoglobin)
11. Differential leukocyte count (DLC)
12. Recognition and staining of various types of blood cells (normal and abnormal)
13. Preparation of thick and thin blood smear for malarial parasite (Leishman/Giemsa/JSB)
14. RBC counting
15. WBC counting
16. Platelet counting
17. Routine Examination of urine

### **BMLS-303: Biochemical Metabolism**

**Rationale:** 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.

1. Carbohydrate Metabolism
  - 1.1 Introduction, Importance and Classification
  - 1.2 Digestion and Absorption
  - 1.3 Metabolism: - Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenolysis, Glycogenesis
  - 1.4 Disorders of carbohydrate metabolism.
2. Protein Metabolism
  - 2.1 Introduction, Importance and classification
  - 2.2 Important properties of proteins
  - 2.3 Digestion & absorption of Proteins
  - 2.4 Protein synthesis
  - 2.5 Metabolism of proteins
  - 2.6 Disorders of protein metabolism and Urea Cycle
3. Lipid
  - 3.1 Introduction & Classification
  - 3.2 Digestion & absorption of fats
  - 3.3 Lipoproteins
  - 3.4 Fatty acid biosynthesis & fatty acid oxidation
4. Nucleic Acid
  - 4.1 Introduction
  - 4.2 Functions of Nucleic acid
  - 4.3 Functions of energy carriers
5. Enzymes
  - 5.1 Introductions, Importance & Classifications
  - 5.2 Properties of enzymes
  - 5.3 Mechanism of enzyme action
  - 5.4 Factors affecting enzyme action
  - 5.5 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

### **BMLS-303: Biochemical Metabolism – Practical**

1. To determine the presence of carbohydrates by Molisch 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

### **BMLS-304: Fundamentals of Histology**

**Rationale:** The student will study diseases associated with different body organs and systems.

Topics include:

1. Alimentary System: Diseases of mouth, Diseases of Esophagus- Esophageal varices.
2. Digestive System: Gastritis, Peptic ulceration, Appendicitis microbial diseases, food poisoning, hernia, Intestinal obstructions & mal absorption.
3. Accessory Digestive glands: Salivary glands- mumps
  - 3.1 Liver – hepatitis, liver failure, cirrhosis.
  - 3.2 Pancreas- pancreatitis.
  - 3.3 Gall Bladder- Gall stones, jaundice and cardiovascular diseases.
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.
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.
9. Endocrine System:
  - 9.1 Pituitary: Hyper & Hypo secretions
  - 9.2 Thyroid: Goiter
  - 9.3 Adrenal: Cushing Syndrome, Addison Disease
  - 9.4 Pancreas: Diabetes
10. Sense Organs:
  - 10.1 Ear: Otitis
  - 10.2 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 by KL Mukherjee-Volume III
5. Text book of Pathology by Robbins

### **BMLS-304 Fundamentals of Histology – Practical**

1. To study squamous cell from cheek cells (Buccal mucosa)
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 and draw diagram in practical notebook
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

## *Fourth Semester*

### **BMLS-401 Applied Bacteriology**

**Rationale:** This part will cover the laboratory strategy in the diagnosis of various infective syndromes i.e. choice of samples, collection and transportation and processing of samples for isolation of bacterial pathogens and then to put antibiotic susceptibility testing. This will also cover bacteriological examination of water, milk, food, air, I/V fluids and nosocomial infections. Further it will make the candidate familiar to epidemiology, epidemiological markers and preservation of microbes.

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:
  - 1.1 Septicemia and bacteremia
  - 1.2 Upper Respiratory tract infections
  - 1.3 Lower respiratory tract infections
  - 1.4 Wound, skin, and deep sepsis
  - 1.5 Urinary tract infections
  - 1.6 Genital Tract infections
  - 1.7 Meningitis
  - 1.8 Gastro intestinal infections
  - 1.9 Enteric fever
  - 1.10 Tuberculosis (Pulmonary and Extra-pulmonary)
  - 1.11 Pyrexia of unknown origin
2. Antibiotic susceptibility testing in bacteriology
  - 2.1 Definition of antibiotics
  - 2.2 Culture medium used for Antibiotic susceptibility testing
  - 2.3 Preparation and standardization of inoculum
  - 2.4 Control bacterial strains
  - 2.5 Choice of antibiotics
  - 2.6 MIC and MBC: Concepts and methods for determination
  - 2.7 Various methods of Antibiotic susceptibility testing with special reference to Stokes

- and Kirby-Bauer method
3. Basics of Nucleic acid techniques in diagnostic microbiology with special reference to Polymerase chain reaction (PCR)
  4. Automation in bacterial culture detection and antimicrobial susceptibility testing: Principles and importance.
  5. Bacteriological examination of water, milk, food and air
    - 5.1 Examination of water
      - 5.1.1 Collection and transportation of water sample
      - 5.1.2 Presumptive coliform count
      - 5.1.3 Eijkman test
      - 5.1.4 Introduction and importance of other bacteria considered as indicators of fecal contamination
      - 5.1.5 Membrane filtration tests
      - 5.1.6 Interpretation of results
    - 5.2 Examination of Milk and milk products
      - 5.2.1 Basic Concepts regarding gradation of milk
      - 5.2.2 Various tests for Bacteriological examination of milk
    - 5.3 Examination of food articles
      - 5.3.1 Basic Concepts regarding classification of food like frozen food, canned food, raw food, cooked food etc.
      - 5.3.2 Various tests for Bacteriological examination with special reference to food poisoning bacteria
    - 5.4 Examination of Air
      - 5.4.1 Significance of air bacteriology in healthcare facilities
      - 5.4.2 Settle plate method
      - 5.4.3 Types of air sampling instruments
      - 5.4.4 Collection processing and reporting of an air sample
  6. Sterility testing of I/v fluids
    - 6.1 Collection, transportation and processing of I/v fluids for bacterial contamination
    - 6.2 Recording the result and interpretation
  7. Nosocomial Infection:
    - 7.1 Introduction, sources and types of nosocomial infections.
    - 7.2 Surveillance of hospital environment for microbial load.
    - 7.3 Role of microbiology laboratory in control of nosocomial infections
  8. Epidemiological markers:
    - 8.1 Introduction
    - 8.2 Types
    - 8.3 Serotyping
    - 8.4 Phage typing and
    - 8.5 Bacteriocin typing
  9. Preservation methods for microbes
    - 9.1 Basic concepts of preservation of microbes
    - 9.2 Why do we need to preserve bacteria?
    - 9.3 Principle and procedures of various short term and long term preservation methods with special reference to Lyophilization

### **Suggested Readings:**

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
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 Monica Cheesbrough
6. Hospital Acquired Infections-Power strategies for clinical practice by Dr. V Muralidhar and Sumathi Murlidhar
7. Control of Hospital infection-A practical Handbook by GajAylyffe, A.P. Fraise, A.M. Geddes, K. Mitchell

### **BMLS-401: Applied Clinical Bacteriology – Practical**

1. Inoculation of different culture media
2. Isolation of pure cultures
3. Processing of following clinical samples for culture and identification of bacterial pathogens:
  - 3.1 Blood
  - 3.2 Throat swab
  - 3.3 Sputum
  - 3.4 Pus
  - 3.5 Urine
  - 3.6 Stool for Salmonella, Shigella and Vibrio cholerae
  - 3.7 C.S.F. and other body fluids
4. Demonstration of PCR
5. Demonstration of automation in bacterial culture detection and antimicrobial susceptibility testing
6. Antimicrobial susceptibility testing
  - 6.1 Introduction and terms used
  - 6.2 Preparation and standardization of inoculum
  - 6.3 To demonstrate reference bacterial strains
  - 6.4 To determine MIC and MBC of known bacteria against a known antibiotic
  - 6.5 To perform antibiotic susceptibility testing of clinical isolates by using
    - 6.5.1 Stokes method
    - 6.5.2 Kirby-Bauer method
7. Collection, transportation and processing of following articles for bacteriological examination:
  - 7.1 Water
  - 7.2 Milk
  - 7.3 Food and
  - 7.4 Air
8. To demonstrate sterility testing of intravenous fluid with positive and negative controls
9. Demonstration of serotyping and bacteriocin typing
10. Demonstration of lyophilization and other available preservation methods

### **BMLS-402: Applied Haematology-I**

**Rationale:** The students will be made aware of the methods of estimating different components of blood. Students will learn the basic concepts of staining and coagulation in Haematology laboratory.

1. Haemoglobinometry: Different methods to measure Haemoglobin with merits and demerits
2. Haemocytometry: Introduction, Principle, Reagent preparation, procedure, errors involved and means to minimize errors.
  - 2.1 RBC Count,
  - 2.2 Total leucocytes count(TLC)

- 2.3 Platelet Count.
- 2.4 Absolute Eosinophil count
3. Principle mechanism and different methods with merit and demerits for the measuring Erythrocyte Sedimentation Rate(ESR) and its significance
4. Different methods with merit and demerits for packed cell volume/Haematocrit value
5. Preparation of blood films
  - 5.1 Types, Methods of preparation (Thick and thin smear/film) and utility
6. Staining techniques in Haematology (Romanowsky's stains): Principle, composition, preparation of staining reagents and procedure of the following
  - 6.1 Giemsa's stain
  - 6.2 Leishman's stain
  - 6.3 Wright's stain
  - 6.4 Field's stain
  - 6.5 JSB stain.
7. Differential leucocytes count(DLC)
8. Normal and absolute values in Haematology
9. Physiological variations in Hb, PCV, TLC and Platelets
10. Macroscopic and microscopic examination of seminal fluid
11. Examination of CSF and other body fluids for cytology i.e. pleural, peritoneal and synovial fluid etc.
12. Preparation of Reagents for coagulation studies:
  - 12.1 M/40 Calcium chloride
  - 12.2 Brain Thromboplastin
  - 12.3 Cephalin
  - 12.4 Adsorbed Plasma
13. Screening Tests for coagulation Studies and their significance

### **Suggested Readings:**

1. Textbook of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. Practical Haematology by J.B. Dacie
4. Clinical Diagnosis & Management by Laboratory methods (20<sup>th</sup> edition) by John Bernard Henry
5. Atlas of Haematology by G.A. McDonald
6. De Gruchy's Clinical Haematology in medical practice

### **BMLS-402: Applied Haematology-I – Practical**

1. Hb Estimation
  - 1.1 Sahli's method
  - 1.2 Cyanmethaemoglobin method
  - 1.3 Oxyhaemoglobin method
2. Total leukocyte count
3. Platelets count
4. Absolute Eosinophil count
5. Preparation of smear and staining with Giemsa and Leishman stain.
6. ESR (Wintrobe and Westergren method)
7. Packed cell volume (Macro&Micro)
8. Cytological examination of CSF and other body fluids
9. Physical and Microscopic examination of seminal fluid including sperm count
10. Perform normal DLC

11. Preparation of M/40 Calcium chloride
  - 11.1 Brain thromboplastin and standardization
  - 11.2 Cephalin
  - 11.3 Adsorbed plasma
12. Perform BT, CT, Hess test, PT and APTT

### **BMLS-403: Analytical Clinical Biochemistry**

#### **Rationale**

The students will learn basic principles/mechanisms, procedures and various types of techniques commonly performed in analytical biochemistry such as:

1. Spectrophotometry and colorimetry
  - 1.1 Introduction
  - 1.2 Theory of spectrophotometry and colorimetry
  - 1.3 Lambert's law and Beer's law
  - 1.4 Applications of colorimetry and spectrophotometry
2. Photometry
  - 2.1 Introduction
  - 2.2 General principles of flame photometry
  - 2.3 Limitations of flame photometry
  - 2.4 Instrumentation
  - 2.5 Applications of flame photometry
  - 2.6 Atomic absorption spectroscopy – Principle & applications
3. Chromatography
  - 3.1 Introduction
  - 3.2 Types of chromatography
  - 3.3 Paper Chromatography: Introduction, principle, types, details for qualitative and quantitative analysis, application
  - 3.4 Thin layer chromatography: Introduction, experimental techniques, application of TLC, limitations, High performance thin layer chromatography
  - 3.5 Column chromatography: Introduction, principle column efficiency, application of column chromatography
  - 3.6 Gas chromatography: Introduction principle, instrumentation, application
  - 3.7 Ion exchange chromatography: Introduction, Definition and principle, cation and anion exchangers, application
4. Gel Chromatography: Introduction Principle and method, application and advantages  
Electrophoresis:
  - 4.1 Introduction
  - 4.2 Principle
    - 4.2.1 Instrumentation
    - 4.2.2 Applications
  - 4.3 Types of electrophoresis
    - 4.3.1 Paper electrophoresis
    - 4.3.2 Gel electrophoresis

#### **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 Chatterjee, Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet&Voet
9. Biochemistry by Stryer

### **BMLS-403: Analytical Clinical Biochemistry- Practical**

1. To demonstrate the principle, working & maintenance of spectrophotometer.
2. To demonstrate the principle, working & maintenance of colorimeter.
3. To demonstrate the principle, working & maintenance of flame photometer.
4. To demonstrate the principle, procedure of paper chromatography.
5. To demonstrate the principle & procedure of Gas chromatography.
6. To demonstrate the principle & demonstration of TLC.
7. To demonstrate the principle & procedure of column chromatography.
8. To demonstrate the principle & procedure of Electrophoresis.

### **BMLS-404: Applied Histopathology-I**

**Rationale:** 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.

1. Introduction to Histotechnology
2. Compound microscope:
  - 2.1 Optical system, magnification and maintenance
  - 2.2 Microscopy:
    - 2.2.1 Working principle
    - 2.2.2 Applications of various types of microscopes i.e. dark field, polarizing, phase contrast, interference and fluorescent microscope
3. Care and maintenance of laboratory equipment used in histotechnology
4. Safety measures in a histopathology laboratory
5. Basic concepts about routine methods of examination of tissues
6. Collection and transportation of specimens for histological examination
7. Basic concepts of fixation
8. Various types of fixatives used in a routine histopathology laboratory
  - 8.1 Simple fixatives
  - 8.2 Compound fixatives
  - 8.3 Special fixatives for demonstration of various tissue elements
9. Decalcification
  - 9.1 Criteria of a good decalcification agent
  - 9.2 Technique of decalcification followed with selection of tissue, fixation, and decalcification, neutralization of acid and thorough washing
  - 9.3 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
10. Processing of various tissues for histological examination
  - 10.1 Procedure followed by Dehydration, Clearing, Infiltration and routine timing schedule for manual or automatic tissue processing.
  - 10.2 Components & principles of various types of automatic tissue
  - 10.3 Processors
  - 10.4 Embedding:



- 10.4.1 Definition
- 10.4.2 Various types of embedding media
- 11. Section Cutting
  - 11.1 Introduction regarding equipment used for sectioning
  - 11.2 Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping, various types of microtome and their applications
  - 11.3 Freezing Microtome and various types of Cryostats.
  - 11.4 Faults in paraffin section cutting with reason and remedy, spreading the sections and attachment or mounting of sections to glass slides.
- 12. Staining, Impregnation and Mountants
  - 12.1 Theory of Staining, Classifications of Dyes, Principles of Dye Chemistry
  - 12.2 Stains and Dyes and their uses
  - 12.3 Types of Stains, Chemical Staining Action, Mordants and Accentuators, Metachromasia
  - 12.4 Use of Controls in Staining Procedures
  - 12.5 Preparation of Stains, solvents, aniline water and buffers etc.
  - 12.6 Commonly used mountants in histotechnology lab
  - 12.7 General Staining Procedures for Paraffin Infiltrated and Embedded tissue
  - 12.8 Nuclear Stains and Cytoplasmic stains
  - 12.9 Equipment and Procedure for manual Staining and Automatic Staining Technique
  - 12.10 Mounting of Cover Slips, Labeling and Cataloguing the Slides
- 13. Routine Staining Procedures
  - 13.1 Haematoxylin and Eosin Staining, various types of Haematoxylin 13.2 Mallory's Phosphotungstic Acid Haematoxylin (PTAH)

### **Suggested Readings**

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft

### **BMLS-404: Applied Histopathology-I - Practical**

1. Demonstration of instruments used for dissection
2. Use of antiseptics, disinfectants and insecticides in a tissue culture processing laboratory
3. Reception and labeling of histological specimens
4. Preparation of various fixatives
  - 4.1 Helly's fluid
  - 4.2 Zenker's fluid
  - 4.3 Bouin's fluid
  - 4.4 Corney's fluid
  - 4.5 10% Neutral formalin
  - 4.6 Formal saline
  - 4.7 Formal acetic acid
  - 4.8 Pereyn's fluid
5. Testing of melting point of paraffin wax and perform embedding of given tissue in paraffin block
6. To process a bone for decalcification
7. To prepare ascending and descending grades of 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), and types of disposable blades in use (High and Low Profile).
11. To perform section cutting (Rough and Fine)
12. To practice attachment of tissue sections to glass slides
13. To learn using tissue floatation bath and drying of sections in oven (60-65C)
14. To perform & practice the Haematoxylin and Eosin staining technique
15. To perform & practice the Mallory's Phospho tungstic Acid Haematoxylin (PTAH)
16. To learn mounting of stained smears

## *Fifth Semester*

### **BMLS-501: Immunology and Bacterial Serology**

**Rationale:** 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.

1. History and introduction to immunology
2. Immunity
  - 2.1 Innate
  - 2.2 Acquired immunity
  - 2.3 Basic concepts about their mechanisms
3. Definition, types of antigens and determinants of antigenicity
4. Definition, types, structure and properties of immunoglobulin
5. Antigen-Antibody reactions
  - 5.1 Definition
  - 5.2 Classification
  - 5.3 General features and mechanisms
  - 5.4 Applications of various antigen antibody reactions
6. Principle, procedure and applications of under mentioned in Medical Microbiology:
  - 6.1 Complement fixation test
  - 6.2 Immuno- fluorescence
  - 6.3 ELISA
  - 6.4 SDS-PAGE
  - 6.5 Western blotting
7. Principle, procedure and interpretation of various serological tests:
  - 7.1 Widal
  - 7.2 VDRL
  - 7.3 ASO
  - 7.4 CRP
  - 7.5 Brucella tube agglutination
  - 7.6 Rose-Waaler
8. Complement system:
  - 8.1 Definition
  - 8.2 Basic concepts about its components
  - 8.3 Complement activation pathways
9. Immune response:
  - 9.1 Introduction
  - 9.2 Basic concepts of Humoral and Cellular immune responses
10. Hypersensitivity:
  - 10.1 Definition
  - 10.2 Types of hypersensitivity reactions

11. Basic concepts of autoimmunity and brief knowledge about autoimmune diseases
12. Automation in diagnostic serology
13. Vaccines:
  - 13.1 Definition
  - 13.2 Types
  - 13.3 Vaccination schedule
  - 13.4 Brief knowledge about Extended programme of immunization (EPI) in India

### **Suggested Readings:**

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
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 Monica Cheesbrough
6. Immunology by Riot
7. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites

### **BMLS-501: Immunology and Bacterial Serology – Practical**

1. Collection of blood sample by vein puncture, separation and preservation of serum
2. Performing Haemolysin titration for Rose-Waaler test
3. Preparation of Phosphate buffers, Verinol buffer, ASO buffer, Richardson's buffer, Buffers of different pH and Molarity, Tris buffer, Standardization of cell concentration by Spectrophotometer
4. Performance of Serological tests i.e.
  - 4.1 Widal,
  - 4.2 Brucella Tube Agglutination,
  - 4.3 VDRL (including Antigen Preparation),
  - 4.4 ASO (Anti-Streptolysin O)
  - 4.5 C-Reactive Protein (Latex agglutination)
  - 4.6 Rheumatoid factor (RF) Latex agglutination
  - 4.7 Rose Waaler test,
5. Demonstration of antigen/antibody determination by Immuno fluorescence (IF), Immunodiffusion, precipitation in Agarose gel (Ouchterlony), CIEP, ELISA, SDS - PAGE and Western blotting.

### **BMLS-502: Applied Haematology-II**

**Rationale:** The students will be made aware of the safety precautions in Haematology, basic concepts of Automation, quantitative assay of coagulation factors, Karyotyping etc. and will learn about concepts such as 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.

1. Safety precautions in Haematology
2. Basic concepts of automation in Haematology with special reference to:
  - 2.1 Blood cell counter
  - 2.2 Coagulometer
3. Bone marrow examination

- 3.1 Composition and functions
- 3.2 Aspiration of bone marrow (Adults and children)
- 3.3 Processing of aspirated bone marrow (Preparation & staining of smear)
- 3.4 Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios)
- 3.5 Processing and staining of trephine biopsy specimens
4. Red cell anomalies
  - 4.1 Morphological changes such as variation in size shape & staining character.
5. Reticulocytes: Definition, different methods to count, Absolute reticulocyte count and IRF (Immature reticulocyte fraction) and significance of reticulocytes.
6. Lupus Erythematosus (L.E) cell phenomenon.
  - 6.1 Definition of L.E. cell.
  - 6.2 Demonstration of L.E. cell by various methods.
  - 6.3 Clinical significance.
7. Correction studies for Factor deficiency
8. Quantitative assay of coagulation factors
  - 8.1 Principle
  - 8.2 Procedure
9. Screening of inhibitors
  - 9.1 Inhibitors against coagulation factors
  - 9.2 APLA
10. Karyotyping: Chromosomal studies in hematological disorders (PBLC and Bone marrow)
11. Cyto-chemical staining: Principles, method and significance
12. Biomedical waste management in Haematology laboratory (Other than Radioactive material)

### **Suggested Readings**

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KL Mukherjee Volume-I
3. Practical Haematology by JB Dacie
4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henary
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's clinical Haematology in medical practice

### **BMLS-502: Applied Haematology-II – Practical**

1. Review the morphology of Normal and abnormal RBCs
2. Review the morphology of normal and immature WBCs
3. WBCs anomalies
4. Calculating INR and determining the ISI of thromboplastin
5. Quantitative Factor assays:
  - 5.1 Factor VIII
  - 5.2 Factor IX
  - 5.3 Factor VII
  - 5.4 Factor X
  - 5.5 Factor V
6. Quantification of inhibitors (Bethesda method)
7. APLA : Lupus Anticoagulant (LA)
8. Anti-cardiolipin antibodies (ACA)
9. Perform Euglobulin clot lysis test (ELT)

10. Urea clot solubility test for factor XIII.

### **BMLS-503: Applied Clinical Biochemistry–I**

**Rationale:** The students will be taught about Hazards & safety measures in a clinical biochemistry lab, Quality control and quality assurance, Laboratory organization, management Principles of assay procedures and Radioactivity.

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 records
4. Principles of assay procedures, Normal range in blood, Serum, Plasma and Urine and reference values for:
  - 4.1 Glucose
  - 4.2 Proteins
  - 4.3 Urea
  - 4.4 Uric acid
  - 4.5 Creatinine
  - 4.6 Bilirubin
  - 4.7 Lipids
5. Principles, procedures for estimation & assessment of the following including errors involved and their corrections

- 5.1 Sodium, Potassium and Chloride, Iodine
- 5.2 Calcium, Phosphorous and Phosphates
- 6. Instruments for detection of Radioactivity
- 7. Applications of Radioisotopes in clinical biochemistry.
- 8. Enzyme linked immune sorbent assay

### **Suggested Readings**

- 1. Text book of Medical Laboratory Technology by P.B. Godkar.
- 2. Medical Laboratory Science, 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 Chatterjee&Shinde.
- 6. Principal of Biochemistry by Lehninger
- 7. Biochemistry by Voet&Voet
- 8. Biochemistry by Stryer

### **BMLS-503: Applied Clinical Biochemistry–I - 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, Inorganic phosphate
- 12. To measure electrolytes Sodium, Potassium & Chloride.

### **BMLS-504: Applied Histopathology-II**

**Rationale:** Students will learn about various staining procedures for demonstration of different substances. The students will learn about special staining procedures, its handling & testing of various histological specimens in addition to cryostat sectioning and electron microscopic procedures

- 1. Cryostat sectioning, its applications in diagnostic histopathology.
- 2. Special Staining Procedures for detection of
  - 2.1 Connective tissue elements, Trichrome staining, muscle fibers, elastic, reticulin fibers, collagen fibers etc.
  - 2.2 Metachromatic staining such as Toluidine blue on frozen sections
  - 2.3 Principles of metal impregnation techniques.
  - 2.4 Demonstration and identification of minerals and pigments, removal of Pigments/artifacts in tissue sections
- 3. Demonstration of Proteins & nucleic acids.
- 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, and muscle biopsy, under calcified or unclarified bones, whole brain, and whole lungs including other large organs.
- 7. Enzyme histochemistry: Diagnostic applications and the demonstration of

- Phosphatases, Dehydrogenases, Oxidases & Peroxidases.
- 8. Vital staining.
- 9. Neuro-pathological techniques.
- 10. Museum techniques.
- 11. Electron Microscope:
  - 11.1 working principle and its components
  - 11.2 Processing, embedding and ultra-microtomy
- 12. Micrometry and Morphometry

### **Suggested Readings**

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft

### **BMLS-504: Applied Histopathology-II - Practical**

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 Periodic Acid Schiff's (PAS) 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 by Van Gieson's Stain
5. To perform Masson's trichrome stain on a paraffin section for the demonstration of collagen fiber, muscle fiber and other cell elements.
6. To stain the paraffin section for the demonstration of the elastic fibers (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 Mucicarmine, Alcian 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 using the following staining procedures:
  - 10.1 Gram's staining
  - 10.2 AFB staining (Ziehl Neilson's staining) for M. tuberculosis and leprae
  - 10.3 Grocott's stain for fungi
  - 10.4 Schmorl's reaction for reducing substances (melanin)
11. To stain for nucleic acid (DNA and RNA)
  - 11.1 Feulgen Staining
  - 11.2 Methyl Green-Pyronin Staining
  - 11.3 Enzymatic methods

## *Sixth Semester*

### **BMLS-601: Medical Parasitology and Entomology**

#### **Rationale**

The student will be taught about introduction, general characteristics, life cycle and laboratory diagnosis of various medically important parasites.

1. Introduction to Medical Parasitology with respect to terms used in Parasitology.

2. Protozoology/ Protozoal parasites:
  - 2.1 General characteristics of protozoa.
  - 2.2 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Entamoeba sp.
  - 2.3 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Intestinal and vaginal flagellates i.e. Giardia, Trichomonas sp.
  - 2.4 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of blood and tissue flagellates i.e. Plasmodium and Toxoplasma sp.
3. Helminthology/ Helminthic parasites:
  - 3.1 General characteristics of Cestodes, Trematodes and Nematodes
  - 3.2 Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of:
    - 3.2.1 Taenia solium and saginata
    - 3.2.2 Echinococcus granulosus
    - 3.2.3 Hymenolepis nana
    - 3.2.4 Schistosoma haematobium and mansoni
    - 3.2.5 Fasciola hepatica and buski
    - 3.2.6 Trichuris trichura
    - 3.2.7 Trichinella spirales
    - 3.2.8 Strongyloides stercoralis
    - 3.2.9 Ancylostoma duodenale
    - 3.2.10 Enterobius vermicularis
    - 3.2.11 Ascaris lumbricoides
    - 3.2.12 Wuchereria bancrofti
    - 3.2.13 Dracunculus medinensis
4. Diagnostic procedures:
  - 4.1 Examination of Stool for parasites
    - 4.1.1 For intestinal protozoal infections
    - 4.1.2 General rules for microscopic examination of stool samples
    - 4.1.3 Collection of stool samples
    - 4.1.4 Preparation of material for unstained and stained preparations
    - 4.1.5 Staining methods i.e. Iodine staining and permanent staining
    - 4.1.6 For Helminthic infections
      - 4.1.6.1 Introduction, direct smear preparation and examination
      - 4.1.6.2 Concentration techniques i.e. Flotation and sedimentation techniques
      - 4.1.6.3 Egg counting techniques
    - 4.1.7 Examination of blood for parasites
      - 4.1.7.1 Preparation of thin and thick blood film
      - 4.1.7.2 Leishman staining
      - 4.1.7.3 Examination of thick and thin smear
      - 4.1.7.4 Field's stain
      - 4.1.7.5 JSB stain
5. Examination of blood film for Malarial parasite and Microfilariae
6. Collection, Transport, processing and preservation of samples for routine parasitological investigations
7. Morphology, life cycle and lab-diagnosis of Giardia and Entamoeba
8. Morphology, life cycle and lab-diagnosis of Roundworms and Hookworms
9. Morphology, life cycle and lab-diagnosis of T. solium and T. saginata
10. Morphology, life cycle and lab-diagnosis of Malarial parasite with special reference to P. vivax and P. falciparum
11. Laboratory diagnosis of hydated cyst and cysticercosis



12. Concentration techniques for demonstration of Ova and Cysts (Principles and applications)

### **Suggested Readings**

1. Parasitology in relation to Clinical Medicine by K D Chhatterjee
2. Medical Entomology by A.K. Hati, Pub. Allied Book Agency
3. Medical Parasitology by D.R. Arora
4. Clinical Parasitology by Paul Chester Beaver

### **BMLS-601: Medical Parasitology and Entomology – Practical**

1. Routine stool examination for detection of intestinal parasites with concentration methods:
  - 1.1 Saline preparation
  - 1.2 Iodine preparation
  - 1.3 Floatation method
  - 1.4 Centrifugation method
  - 1.5 Formal ether method
  - 1.6 Zinc sulphate method
2. Identification of adult worms from models/slides:
  - 2.1 Tapeworm
  - 2.2 Tapeworm segments
  - 2.3 Ascaris (Round worm)
  - 2.4 Hookworms
  - 2.5 Pinworms
3. Malarial parasite:
  - 3.1 Preparation of thin and thick smears
  - 3.2 Staining of smears
  - 3.3 Examination of smears for malarial parasites (*P. vivax* and *P. falciparum*)

### **BMLS-602: Advanced Haematology**

#### **Rationale**

The students will be made aware of different anemia, Leukemia, chromosomal studies, bleeding disorders and radiation hazards

1. Laboratory diagnosis of Iron deficiency anemia
2. Laboratory diagnosis of Megaloblastic anemia & Pernicious anemia
3. Classification and Laboratory diagnosis of Hemolytic anemia
4. Definition, classification and laboratory diagnosis of Leukemia
5. Chromosomal studies in various hematological disorders and their significance.
6. Laboratory diagnosis of bleeding disorders with special emphasize to
  - 6.1 Hemophilia A, B & Von-Willebrand disease
  - 6.2 DIC
  - 6.3 Platelet disorder (Qualitative and quantitative)
7. Laboratory approach for investigating thrombosis.
8. Using radioisotopes measurement of:
  - 8.1 Blood volume
  - 8.2 Determination of Red cell volume and Plasma volume
  - 8.3 Red cell life span
  - 8.4 Platelet life span

- 8.5 Radiation hazards and its prevention
- 8.6 Disposal of radioactive material

### **Suggested Readings**

- 1. Text book of Medical Laboratory Technology by Paraful B. Godkar
- 2. Medical laboratory Technology by KL Mukherjee Volume-I
- 3. Practical Haematology by JB Dacie
- 4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henary
- 5. Atlas of Haematology (5th edition) by G.A. McDonald
- 6. De Gruchy's clinical Haematology in medical practice
- 7. Postgraduate Haematology by Hoffbrand

### **BMLS-602: Advanced Haematology – Practical**

- 1. Study and interpretation of Histogram of Automated Blood cell counter
- 2. To estimate serum iron and total iron binding capacity.
- 3. Screening tests for enzymes deficiency: Pyruvate Kinase, G6PD
- 4. To estimate Hb-F, Hb-A2 in a given blood sample.
- 5. To estimate plasma and urine Hemoglobin in the given specimens.
- 6. To demonstrate the presence of Hb-S by Sickling and Solubility tests.
- 7. Perform Hb electrophoresis (alkaline)
- 8. Perform osmotic red cell fragility.
- 9. Detection of Fibrin degradation products (FDPs)
- 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.
- 11. Estimation of Protein C, S
- 12. Peripheral Blood Lymphocyte Culture for chromosome studies in Leukemia.

### **BMLS-603: Applied Clinical Biochemistry- II**

#### **Rationale:**

The students will learn how to analyze various clinical patients' 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.

- 1. Automation in clinical biochemistry
- 2. Method of estimation and assessment for:
  - 2.1 Glucose tolerance test
  - 2.2 Insulin tolerance test
  - 2.3 Xylose excretion test.
- 3. Gastric analysis.
- 4. Clearance test for renal function.
- 5. Qualitative test for:
  - 5.1 Urobilinogens
  - 5.2 Barbiturates
  - 5.3 T3, T4 and TSH
  - 5.4 Ketosteroids

6. Enzymes:
  - 6.1 Principles
  - 6.2 Clinical significance and
  - 6.3 Procedures for estimation
    - 6.3.1 Acid phosphatase
    - 6.3.2 Alkaline phosphatase
    - 6.3.3 Lactate dehydrogenase
    - 6.3.4 Aspartate transaminase
    - 6.3.5 Alanine transaminase
    - 6.3.6 Creatine phosphokinase
7. Qualitative analysis of Renal calculi.
8. Chemical examination of Cerebrospinal fluid.
9. Brief knowledge about rapid techniques in clinical biochemistry

### **Suggested Readings**

1. Text book of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Science, 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 Chatterjee & Shinde.
6. Principles of Biochemistry by Lehninger
7. Biochemistry by Voet & Voet
8. Biochemistry by Stryer

### **BMLS-603: Applied Clinical Biochemistry-II – 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

### **BMLS-604: Cytopathology**

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

1. Cryostat sectioning, its applications in diagnostic cytopathology
2. Enzyme Cytochemistry:
  - 2.1 Diagnostic applications
  - 2.2 Demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases
3. Vital staining for Sex Chromatin
4. Aspiration cytology:
  - 4.1 Principle
  - 4.2 Indications & utility of the technique with special emphasis on role of cytotechnologist in FNAC clinics

5. Exfoliative cytology (Papanicolaou technique for the staining of cervical smears)
  - 5.1 Cervical cytology
  - 5.2 Fluid Cytology
    - 5.2.1 Urine
    - 5.2.2 CSF
    - 5.2.3 Body Fluids (Pleural, Pericardial, Ascitic)
6. Automation in cytology
7. Liquid based cytology: Principles and preparation, Cyto centrifuge, molecular cytology, Cell Block and Immune-cytochemistry

### **Suggested Readings**

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft
5. Diagnostic Cytology by Koss Volume -II

### **BMLS-604: Cytopathology – Practical**

1. To perform Papanicolaou's stain on cervical smear
2. To perform Guard's staining for demonstration sex chromatin (Barr bodies on a buccal smear)
3. To perform Shorr's staining for Hormonal assessment
4. To cut frozen sections of Gynaec tissue
5. To perform CSF sample and body fluids by cytopspin
6. Should know the various stains used in Cytology lab: May Grunwald Giemsa, H&E, PAS, Grocott's.

## *Seventh Semester*

### **BMLS-701 Virology and Mycology**

#### **Rationale**

The student will be taught about introduction, general characteristics, life cycle and laboratory diagnosis of various Medically Important Fungi and Viruses.

#### **Virology:**

1. Introduction to medical virology
2. Introduction to medically important viruses
3. Structure and Classification of viruses.
4. Multiplication of viruses
5. Collection, transportation and storage of sample for viral diagnosis
6. Staining techniques used in Virology
7. Processing of samples for viral culture (Egg inoculation and tissue culture)
8. Rapid diagnosis of viral infections with special reference to HIV, HBV and HCV
  - 8.1 EIA
  - 8.2 Immunofluorescence
  - 8.3 PCR

#### **Mycology:**

1. Introduction to Medical Mycology

2. Basic concepts about superficial and deep Mycoses
3. Taxonomy and classification and general characteristics of various medically important fungi
4. Normal fungal flora
5. Morphological, cultural characteristics of common fungal laboratory contaminants
6. Culture media used in mycology
7. Direct microscopy in Medical mycology laboratory
8. Processing of clinical samples for diagnosis of fungal infections i.e. Skin, nail, hair, pus, sputum, CSF and other body fluids
9. Techniques used for isolation and identification of medically important fungi
10. Methods for identification of yeasts and moulds
11. Dimorphism in fungi
12. Antifungal susceptibility tests
13. Preservation of fungal cultures
14. Routine myco-serological tests and skin tests

### **Suggested Readings**

1. Practical Medical Microbiology by Mackie & MacCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
3. Medical Microbiology by Panikar & Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol. II Microbiology by Monica Cheesbrough
6. Medical Mycology by Dr. Jagdish Chander

### **BMLS-701: Virology and Mycology – Practical**

1. To prepare culture media used routinely in mycology
2. To perform KOH preparation, Gram stain, Potassium Hydroxide - Calcofluor White method, India Ink preparation, Modified Kinyoun Acid Fast Stain for Nocardia, LCB preparation.
3. To identify given yeast culture by performing various identification techniques studied in theory.
4. To identify given mould culture by performing various identification techniques studied in theory.
5. To demonstrate dimorphism in fungi
6. To collect and process clinical samples for laboratory diagnosis of fungal infections i.e.
  - 6.1 Skin
  - 6.2 Nail
  - 6.3 Hair
  - 6.4 Body fluids and secretions
7. To demonstrate structure of viruses and their multiplication from charts etc.
8. To perform Giemsa stain, Seller's stain, immunofluorescent staining procedures for diagnosis of viral infections
9. Demonstration of fertilized hen egg
10. Demonstration of various inoculation routes in fertilized hen egg

### **BMLS-702: Blood Banking and Genetics**

**Rationale:** Blood banking 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. Genetics will make students learn about Fundamentals of Heredity. The students will learn about the concept of inheritance in various genetic diseases.

### **Blood Banking**

1. Introduction to Blood Banking
2. History and discovery of various blood group systems
3. ABO blood group system
4. Rh and other major blood group system
5. Sources of error in blood grouping and their elimination.
6. ABO grouping: Forward and reverse grouping. Causes of discrimination between forward and reverse grouping
7. Rh grouping
8. Compatibility test in blood transfusion
  - 8.1 Collection of blood for cross matching from a blood bag
  - 8.2 Major cross matching
  - 8.3 Minor cross matching
  - 8.4 Use of enzymes in blood bank specially Papain
9. Complications and hazards of blood transfusion
10. Laboratory investigations of transfusion reactions and mismatched blood transfusion.
11. Precautions while procurement and storage of grouping antisera
12. Various anticoagulants used to collect blood for transfusion purposes
13. Selection of donor and procedure for collection of blood from a healthy donor
14. Preparation of various fractions of blood for transfusion and therapeutic purposes such as:
  - 14.1 Packed red cells, washed red cells and FROZEN Red cells
  - 14.2 Platelet Rich Plasma (PRP), Platelet concentrate and frozen platelets.
  - 14.3 Fresh plasma (FP), Fresh Frozen Plasma (FFP) and cryoprecipitate
15. Brief introduction of blood substitute/artificial blood
16. Haemopheresis: pertaining to Leucocytes, platelets and plasma.
17. Quality control in blood bank

### **Genetics**

1. Continuity of life-heredity, variation;
2. Mendel's laws of inheritance,
3. Chromosomal basis of inheritance; other patterns of inheritance- incomplete dominance, multi parallelism, quantitative inheritance.
4. Chromosomes - bacterial cell and eukaryotic cell; parallelism between genes and chromosomes; genome, linkage and crossing over; gene mapping; recombination;
5. Molecular genetics: DNA as a genetic material- its structure and replication; structure of RNA and its role in protein synthesis, Vectors, plasmids
6. Human Genetics
7. Microbial genetics

### **Suggested readings**

1. Practical Haematology by J.B. Dacie
2. Transfusion Science by Overfield, Hamer
3. Medical Laboratory Technology by K.L. Mukherjee Volume-I

4. Mollison's Blood Transfusion in Clinical Medicine, 12th Edition by Harvey G. Klein
5. Genes by Benjamin Lewin
6. Genetics by B.D. Singh
7. Principals of Genetics by Gardner
8. Instant Notes on Genetics by PC Winter, GI Hickey and HL Fletcher

### **BMLS-702: Blood Banking and Genetics – 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, HBs Ag, Syphilis and HIV
5. To determine the ABO & Rh grouping
  - 5.1 Direct or preliminary grouping
  - 5.2 Indirect or proof grouping
  - 5.3 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
  - 7.1 Major cross matching
  - 7.2 Minor cross matching
8. Preparation of various fractions of blood.

### **BMLS-703: Immunopathology & Molecular Biology**

**Rationale:** The students will learn how to analyze various clinical patients' samples, for estimation of different components which are the cause of the immune disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important cells of immune system, lymphoid organs, antigen, antibody, Ag-Ab. reactions, transplant immunology etc. & automation techniques. Molecular biology concerns the molecular basis of biological activity between biomolecules in the various systems of a cell, including the interactions between DNA, RNA and proteins and their biosynthesis, as well as the regulation of these interactions. A basic introduction of molecular biology and its techniques like PCR, RTPCR etc. will also be rendered to sensitize students to take up future molecular biology challenges.

1. Introduction to Immunology
2. Cells of the immune system
3. Types and Mechanisms of immune response
4. Lymphoid organs of the Immune system
5. MHC I & II
6. HLA Typing & Cross matching
7. Transplant Immunology
8. Hypersensitivity: Definition, Types, Mechanisms
9. Autoimmunity
10. Immune tolerance: Basic concepts
11. Introduction to Molecular Biology
12. Relationship of Mol. Biology with other Science
13. Molecular Biology Techniques: Principle, Reagents used, procedure and applications in Medical diagnostics
  - 13.1 Polymerase Chain Reaction and its advanced versions

- 13.2 Gel electrophoresis
- 13.3 Western blotting
- 14. Chemical composition of DNA
  - 14.1 DNA replication
  - 14.2 DNA damage and repair
  - 14.3 Regulation of prokaryotic and eukaryotic gene expression
  - 14.4 Cell Cycle

### **Suggested Readings**

1. Immunology by Ivan Roitt, Jonathaan Brostoff and David Male
2. Immunology by Kuby
3. Medical Immunology by Daniel P Stites
4. Basic & Clinical Immunology by P. Daniel Fudenberg, H. Hugh and Stites
5. Elements of Biotechnology by PK Gupta
6. Watson Molecular Biology of Gene
7. Advanced Molecular Biology by R Twyman
8. Principal of Biochemistry by Lehninger

### **BMLS-703: Immunopathology & Molecular Biology – Practicals**

1. Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
2. T and B cell separation
3. Immunofluorescence
  - 3.1 Anti- Nuclear Antibody (ANA)
  - 3.2 Anti- Neutrophil Cytoplasmic Antibody (ANCA)
4. AIDS Immunology and Pathogenesis (AIP)
5. Thyroid Microsomal antigen (TMA)- Agglutination reactions
6. Electrophoresis
7. Gel diffusion
8. Nephelometry
9. HLA
  - 9.1 Typing Serology & Cross match
  - 9.2 Molecular Typing
10. Nitro blue Tetrazolium Chloride Test (NBT)
11. FACS for CD4 and CD8
12. ELISA for lab. diagnosis of AIDS
13. Polymerase Chain Reaction and its advanced versions
14. Gel electrophoresis
15. Western blotting
16. Isolation of DNA and RNA
17. Estimation of DNA and RNA
18. Determination of molecular weight and quantification of DNA using agarose gel electrophoresis

### **BMLS-704: Research Methodology and Biostatistics**

**Rationale:** The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in



addition to being given information about the relation between data and variables.

**Research Methodology:**

1. Introduction to research methods
2. Identifying research problem
3. Ethical issues in research
4. Research design
5. Basic Concepts of Biostatistics
6. Types of Data
7. Research tools and Data collection methods
8. Sampling methods
9. Developing a research proposal

**Biostatistics:**

1. Need of biostatistics
2. What is biostatistics: beyond definition
3. Understanding of data in biostatistics
4. How & where to get relevant data
5. Relation between data & variables
6. Type of variables: defining data set
7. Collection of relevant data: sampling methods
8. Construction of study: population, sample, normality and its beyond (not design of study, perhaps)
9. Summarizing data on the pretext of underlined study
10. Understanding of statistical analysis (not methods)

**Suggested readings**

1. Statistical Methods by S.P. Gupta
2. Methods in biostatistics for medical students by B.K. Mahajan
3. RPG Biostatistics by Himanshu Tyagi

**BMLS-704 Research Methodology and Biostatistics – Practical**

1. To practice problems on various biostatistics tools.

## **Eighth Semester**

**BMLS-801 Internship:**

The internship will span 6 months/1 semester. This will include 7-8 hours of practice a day, totaling to 720 hours during internship semester. As a part of this, the students will maintain a work logbook which will be duly endorsed by the supervisor or trainer. At the end of internship, the candidate shall submit the work log book along with certificate from the institute. Finally, the training of candidate shall be evaluated by the internal and external examiners deputed by University/Board in the form of practical / viva examination.

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in clinical delivery of services. Students will demonstrate competence in beginning and intermediate procedures. Students will observe the advanced and

specialized procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction. The students are expected to work for minimum 6 hours per day and this may be more depending on the need and the healthcare setting.

### **Skills based outcomes and monitorable indicators for Medical Laboratory Scientist**

1. Demonstrate professional interpersonal, oral, and written communications skills sufficient to serve the needs of patients and the public including an awareness of how diversity may affect the communication process.
2. Perform pre-analytical, analytical, and post-analytical processes:
  - 2.1 Demonstrate ability to understand investigation/test requisition.
  - 2.2 Collecting the relevant clinical samples along with complete and accurate documentation with proper safety measures in relation to sample accountability.
  - 2.3 To transport the samples with precautionary measures to the relevant lab section.
  - 2.4 Demonstrate the ability to prepare clinical sample for processing.
  - 2.5 To demonstrate the knowledge of accurate sample processing for the required lab investigation. Perform routine clinical laboratory tests in clinical chemistry, hematology/haemostasis, immunology, immunohaematology, microbiology, Histopathology, Cytopathology, body fluid analysis, and laboratory operations.
  - 2.6 Perform mathematical calculations related to all areas of the clinical laboratory
  - 2.7 Ability to record the test results/data.
  - 2.8 To demonstrate the ability to interpret the test reports and its documentation in lab records.
  - 2.9 Demonstrate ability to release the report to the right person in minimum turn-around-time (TAT).
3. Perform problem solving and troubleshooting techniques for laboratory methodologies  
Correlate laboratory test results with patient diagnosis and treatment.
4. To follow basic quality assessment protocol of clinical laboratory.
5. Demonstrate routine laboratory techniques sufficient to orient new employees within the clinical laboratory.
6. Apply basic scientific principles in learning new techniques/procedures; demonstrate application of principles and methodologies.
7. Utilize computer technology applications to interact with computerized instruments and laboratory information systems.
8. Demonstrate adequate knowledge of computer software as it applies to document production, spreadsheets, and presentations.
9. Demonstrate professional behavior with co-team mates.
10. Demonstrate sensitivity and compassion towards patient