SCHEME & SYLLABUS

(Choice Based Credit System)

For

BMLT

(w.e.f. Session 2022-23)

Program Code: MLT 301

DEPARTMENT OF MEDICAL LAB TECHNOLOGY

RIMT UNIVERSITY, MANDIGOBINDGARH, PUNJAB

TABLE OF CONTENTS

RIMT UNIVERSITY MANDI GOBINDGARH, PUNJAB

SECTION 1

Vision & Mission of the University

VISION

To become one of the most preferred learning places a centre of excellence to promote and nurture future leaders who would facilitate in desired change in the society

MISSION

- To impart teaching and learning through cutting edge technologies supported by the world class infrastructure

- To empower and transform young minds into capable leaders and responsible citizens of India instilled with high ethical and moral values

SECTION 2

Vision and Mission of the Department

VISION

The Department of Medical Laboratory Technology represents one of the effective methods to meet the community needs of medical specialties for supporting various research, health, and educational institutions. Besides, it aims to invest the capacities of professors and students in the theoretical and applied researches and scientific studies. It also commits itself to improve training, awareness, and health mobilizations according to new grounds consistent with recent advances.

MISSION

- To create opportunities for students to gain a foothold in the healthcare industry
- To provide sufficient didactic and technical information for the student to understand analytical processes, interpret analytical results and appreciate the clinical significance of analyses performed in a modern clinical laboratory
- To provide the students with qualities and competencies that ensure success in the field of laboratory medicine as a medical laboratory technician
- Moreover, the department has a bright, ambitious future mission to provide the best medical teaching skills, to expand horizons of scientific cooperation with the corresponding departments, and related institutions to achieve continuous and high-quality interactions.

SECTION 3

About the Program

BMLT Program is an Outcome Based Education model which is a 3 year, 6 Semester Full time Program of 208 credit hours with a Choice Based Credit System (CBCS) and Grading Evaluation System. This program comprises of foundational courses, core courses, specialization electives courses, enrichment courses and experimental learning. The suggestive curriculum takes the BMLT program to the next level in terms of implementing Outcome Based Education and to develop management professionals who are knowledgeable in their chosen domain, responsive to the environment and culture, unfailing to the communities, ethical in all doings and with a global outlook and approach.

SECTION 4

Program Educational Objectives (PEOs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PROGRAM EDUCATION OBJECTIVES

PEO1	To create knowledge about core areas related to the field of Medical Laboratory
PEO2	Analyze, interpret and apply concepts of clinical testing for healthcare decision making
PEO3	To exhibit the knowledge of entrepreneurial qualities and explore entrepreneurial opportunities by Working effectively and professionally in teams and enabling them to evaluate investment.
PE04	To employ interpersonal communication skills in relaying laboratory test information and when interacting with patients, lab personnel and other health care professionals.

PROGRAMME OUTCOMES (POs)

PO 1	**Clinical Exposure**:- Apply knowledge and technical skills associated with medical laboratory technology for delivering quality clinical investigations support in number of Hospitals and diagnostics centers for sustainable development.
PO 2	**Technician**:- Perform routine clinical laboratory procedures within acceptable quality control parameters in hematology, biochemistry, immunohematology and microbiology. Recognize the impact of laboratory tests in a global and environmental context.
PO 3	**Social Exposure**:- Demonstrate technical skills, social behavior and professional awareness for functioning effectively as a laboratory technician.
PO 4	**Scientific Exposure**:- These are also several types of positions available, such as research labs, diagnostic Laboratories and management of a team. Apply the fundamental of research process to complete and present research study that enriches the field of physical therapy.
PO 5	**Skill Development**:- Apply problem solving technique in identifications and corrections of pre analytical, post analytical & analytical variable.
PO 6	**Leadership and Team Work -** Function as a leader / team member in diverse professional and industrial research areas. Ability to Communicate effectively by oral, written and graphical means to achieve collaborative cooperation for synergy in an organizational and across organizational boundaries.
PO 7	**Life Long Learning –** Aptitude to acquire newer knowledge and skills, assimilate and adapt them to be ready to confront uncharted environment scientifically and confidently.
PO 8	**Entrepreneurship –** A strong business sense to explore entrepreneurial opportunities and leverage managerial & leadership skills for initiating, leading & managing start-ups as well as professionalizing and growing businesses.
PO 9	**Social Responsiveness and Ethics -** Function in an ethical and professional manner without bias against any ethnicity, race, religion, caste or gender. Practice professional and ethical responsibilities with high degree of credibility, integrity and social concern.
PO 10	**Environment and Sustainability –** Exhibit understanding to assess the impact of managerial decisions and business priorities on the societal, economic and environmental aspects for sustainable development.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Search professional explore about the latest research corners in the field of physical medicine and rehabilitation.
PSO 2	They expertise in advance clinical intervention techniques based on evidence based practices.
PSO 3	After successful completion the students shall be proficient in making diagnosis and skills of testing procedure and techniques.
PSO 4	As a health professional the students shall have an added responsibility towards the community health issue.

SECTION 5

Curriculum / Scheme with Examination Grading Scheme

SEMESTER WISE SUMMARY OF THE PROGRAMME: BMLT

S.no.	Semester	No. of Contact Hours	Marks	Credits
1.	I	34	800	26
2.	II	34	800	26
3.	III	34	800	26
4.	IV	34	800	26
5.	V	34	800	26
6.	VI	34	800	26
7.	VII	34	800	26
8.	VIII	26	200	26
	Total	264	5800	208

EXAMINATION GRADING SCHEME

Marks Percentage Range	Grade	Grade Point	Qualitative Meaning
80.00 - 100.00	O	10	OUTSTANDING
70.00 - 79.99	A+	9	EXCELLENT
60.00 - 69.99	A	8	VERY GOOD
55.00 - 59.99	B+	7	GOOD
50.00 - 54.99	B	6	ABOVE AVERAGE
45.00 - 49.99	C	5	AVERAGE
40.00 - 44.99	P	4	PASS
0.00 - 39.99	E	0	FAIL
	AB	0	Absent

Percentage Calculation: CGPA *10

First Semester – Foundation Course

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-101	Introduction to National Healthcare Delivery System in India	2	-	-	15	35	50	1
BMLS-102	Basic computers and information Science	2	-	-	15	35	50	2
BMLS-103	Communication and soft skills	2	-	-	15	35	50	2
BMLS-104	Medical Terminology, Record keeping (includinganatomical terms) and Orientation to Medical Laboratory Science (MLS)	2	-	-	15	35	50	2
BMLS-105	Medical Law and Ethics	2	-	-	15	35	50	2
BMLS-106	Introduction to Quality and Patient safety (including Basic emergency care and life supportskills, Infection prevention and control, Biomedical waste management, Disastermanagement and Antibiotic resistance)	3	1	-	15	35	50	2
BMLS-107	Professionalism and values	1	-	-	15	35	50	1
BMLS-108	Environmental Science	1	-	-	15	35	50	1
BMLS-109	Principals of Management with special referenceto Medical Laboratory Science (MLS) management	2	1	-	15	35	50	2
BMLS-110	Community orientation and clinical visit	1	-	-	15	35	50	1
BMLS-111	Basic computers and information Science - Practical	-	-	4	15	35	50	2
BMLS-112	Communication and soft skills – Practical	-	-	2	15	35	50	1
BMLS-113	Medical Terminology, Record keeping (includinganatomical terms) and Orientation to Medical Laboratory Science (MLS) – Practical	-	-	2	15	35	50	1
BMLS-114	Introduction to Quality and Patient safety (including Basic emergency care and life	-	-	4	15	35	50	2

	supportskills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance) - Practical							
BMLS-115	Environmental Science – Practical	-	-	2	15	35	50	1
BMLS-116	Principals of Management with special referenceto Medical Laboratory Science (MLS) management-Practical	-	-	2	15	35	50	1
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

NOTE:

1. **Abbreviations: L - Lecture, T - Tutorials and P – Practical**
2. **Considering four months per semester as working months, total contact hour hoursper semester shall be 544 (Five hundred and forty four)**
3. **Teaching resources should be made available at every institute for all basic subjects**

Second Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-201	General Clinical Microbiology	4	-	-	30	70	100	4
BMLS-202	Basic Haematology	4	-	-	30	70	100	4
BMLS-203	Basic Clinical Biochemistry	4	-	-	30	70	100	4
BMLS-204	Human Anatomy and Physiology	4	-	-	30	70	100	4
BMLS-205	General Clinical Microbiology – (Practical)	-	-	4	30	70	100	2
BMLS-206	Basic Haematology – (Practical)	-	-	4	30	70	100	2
BMLS-207	Basic Clinical Biochemistry – (Practical)	-	-	4	30	70	100	2
BMLS-208	Human Anatomy and Physiology – (Practical)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinicallaboratory	-	2	-	-	-	-	2
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

NOTE:

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

Third Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-301	Systematic Bacteriology	4	-	-	30	70	100	4
BMLS-302	Basics of Haematological diseases	4	-	-	30	70	100	4
BMLS-303	Biochemical metabolism	4	-	-	30	70	100	4
BMLS-304	Fundamentals of Histology	4	-	-	30	70	100	4
BMLS-305	Systematic Bacteriology– (Practical)	-	-	4	30	70	100	2
BMLS-306	Basics of Hematological diseases – (Practical)	-	-	4	30	70	100	2
BMLS-307	Biochemical metabolism – (Practical)	-	-	4	30	70	100	2
BMLS-308	Fundamentals of Histology – (Practical)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

NOTE:

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

Fourth Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-401	Applied Bacteriology	4	-	-	30	70	100	4
BMLS-402	Applied Haematology – I	4	-	-	30	70	100	4
BMLS-403	Analytical Clinical Biochemistry	4	-	-	30	70	100	4
BMLS-404	Applied Histopathology – I	4	-	-	30	70	100	4
BMLS-405	Applied Bacteriology– (Practical)	-	-	4	30	70	100	2
BMLS-406	Applied Haematology - I -– (Practical)	-	-	4	30	70	100	2
BMLS-407	Analytical Clinical Biochemistry – (Practical)	-	-	4	30	70	100	2
BMLS-408	Applied Histopathology - I – (Practical)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinicallaboratory	-	2	-	-	-	-	2
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

NOTE:

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

Fifth Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-501	Immunology & Bacterial serology	4	-	-	30	70	100	4
BMLS-502	Applied Haematology – II	4	-	-	30	70	100	4
BMLS-503	Applied Clinical Biochemistry – I	4	-	-	30	70	100	4
BMLS-504	Applied Histopathology - II	4	-	-	30	70	100	4
BMLS-505	Immunology & Bacterial serology – (Practical)	-	-	4	30	70	100	2
BMLS-506	Applied Haematology - II – (Practical)	-	-	4	30	70	100	2
BMLS-507	Applied Clinical Biochemistry – I- (Practical)	-	-	4	30	70	100	2
BMLS-508	Applied Histopathology-II – (Practical)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinicallaboratory	-	2	-	-	-	-	2
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

Sixth Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-601	Medical Parasitology & Entomology	4	-	-	30	70	100	4
BMLS-602	Advanced Haematology	4	-	-	30	70	100	4
BMLS-603	Applied Clinical Biochemistry – II	4	-	-	30	70	100	4
BMLS-604	Cytopathology	4	-	-	30	70	100	4
BMLS-605	Medical Parasitology & Entomology - (Practical)	-	-	4	30	70	100	2
BMLS-606	Advanced Haematology - (Practical)	-	-	4	30	70	100	2
BMLS-607	Applied Clinical Biochemistry – II-- (Practical)	-	-	4	30	70	100	2
BMLS-608	Cytopathology - (Practical)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinicallaboratory	-	2	-	-	-	-	2
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

NOTE:

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

Seventh Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-701	Medical Mycology and Virology	4	-	-	30	70	100	4
BMLS-702	Blood Banking & Genetics	4	-	-	30	70	100	4
BMLS-703	Immunopathology & Molecular Biology	4	-	-	30	70	100	4
BMLS-704	Research methodology and Biostatistics	4	-	-	30	70	100	4
BMLS-705	Medical Mycology and Virology - (Practical)	-	-	4	30	70	100	2
BMLS-706	Blood Banking & Genetics- (Practical)	-	-	4	30	70	100	2
BMLS-707	Immunopathology & Molecular Biology - (Practical)	-	-	4	30	70	100	2
BMLS-708	Research methodology and Biostatistics - (Practical)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinicallaboratory	-	2	-	-	-	-	2
Total		**16**	**2**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**544**						

NOTE:

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

Eighth Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-801	MLS Internship	-	-	720	50	150	200	26
	Total	**-**	**-**	**720**	**50**	**150**	**200**	**26**

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 MLSas per government norms.

SEMESTER-I

First Semester- Foundation course

BMLS-101: 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

   Healthcare delivery system in India at primary, secondary and tertiary care

   Community participation in healthcare delivery system

   Health system in developed countries.

   Private Sector

   National Health Mission

   National Health Policy

   Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme.
3. Introduction to AYUSH system of medicine

   Introduction to Ayurveda.

   Yoga and Naturopathy

   Unani

   Siddha

   Homeopathy

   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-

Demography – its concept

Vital events of life & its impact on demography

Significance and recording of vital statistics

Census & its impact on health policy

6. Epidemiology

Principles of Epidemiology

Natural History of disease

Methods of Epidemiological studies

Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-101.1	Study the health systems of various Countries including India
CO2	BMLS-101.2	Understand , Develop, implement and manage various public health programs.
CO3	BMLS-101.3	Apply various principles of planning and management in implementing health projects and programmes.
CO4	BMLS-101.4	Critically analyze the various components of health care delivery system in India

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

BMLS-102: 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.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-102.1	Students will have knowledge about the basic hardware system of computer and laptop.
CO2	BMLS-102.2	Learners will able to use Microsoft office
CO3	BMLS-102.3	They will be able to install and use various software.

CO4	BMLS-102.4	Learners will be able to get clerical and data entry jobs.

Suggested Readings:

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

BMLS-103: Communication and soft skills

Rationale: The students will be able to appreciate communication skills as these are important toeveryone - they are how we give and receive information and convey our ideas and opinions withthose 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 asdependability and conscientiousness can yield significant return on investment for an organization. For this reason, soft skills are increasingly sought out by employers in addition tostandard 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-103.1	Understand and evaluate key theoretical approaches used in the medical lab field .
CO2	BMLS-103.2	Able to find, use, and evaluate primary academic writing associated with the communication discipline
CO3	BMLS-103.3	Able to communicate effectively orally and in writing
CO4	BMLS-103.4	To develop analytical, management and interpersonal skills, together with the technical knowledge of the work in the medical lab.

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

BMLS-104: Medical Terminology, Record keeping (including anatomical terms) andOrientation to Medical Laboratory Science (MLS)

Rationale: This subject introduces the elements of medical terminology. Emphasis is placed onbuilding 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. The students will be oriented tothe role of medical laboratory professional in healthcare system, scope, purpose, career opportunities in Medical Laboratory science. They will also be introduced to healthcare systemand public health in India.

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.

Orientation to Medical Laboratory Science (MLS)

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
   Role of microbes in human health
   Overview of the role of Medical Laboratory Professional in Medical Microbiology
   Bio-safety in Microbiology
7. Haematology
   Introduction to Haematological diseases
   Overview of the role of Medical lab. professional in Haematology
   Bio-safety in Haematology

8. Histopathology
   Introduction to Tumor pathology
   Overview of the role of Medical lab. professional in Histopathology
   Bio-safety in Histopathology
9. Biochemistry
   Introduction to metabolic disorders
   Overview of the role of Medical lab. professional in Clinical Biochemistry
   Bio-safety in Clinical Biochemistry

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-104.1	Understanding the basic importance of medical terms into their component parts
CO2	BMLS-104.2	Identify combining forms, prefixes, suffixes and terminology associated with each of the body systems.
CO3	BMLS-104.3	Basic knowledge of need and requirements of records in hospitals.
CO4	BMLS-104.4	Understand the importance and types of medical records along with its management

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

BMLS-105: Medical Law and Ethics

Rationale: Legal and ethical considerations are firmly believed to be an integral part of medicalpractice 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 thatform 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 asfollows:

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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-105.1	Learn the basic terminology of subject
CO2	BMLS-105.2	Understand about different legal principles governing the doctor-patient relationship
CO3	BMLS-105.3	Evaluate ethical and legal dilemmas faced by medical practitioners
CO4	BMLS-105.4	Develop understanding of legal arguments on complex and contentious medico-legal issues

Suggested readings:

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

BMLS-106: Introduction to Quality and Patient safety (including Basic emergency careand 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 careand develop skills to implement sustainable quality assurance program in the health system. It will sensitize themin 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.

Concepts of Quality of Care
Quality Improvement Approaches
Standards and Norms

Quality Improvement Tools
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:

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

At the end of this topic, the students should be ableto 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:

Definition of Biomedical Waste
Waste minimization
BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
BMW Management & methods of disinfection

Modern Technology for handling BMW
Use of Personal protective equipment (PPE)
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 –

Evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)],
Prevention & control of common healthcare associated infections,
Components of an effective infection control program, and
Guidelines (NABH and JCI) for Hospital Infection Control

5. Antibiotic Resistance-

History of antibiotics
How resistance happens and spreads
Types of resistance- intrinsic, acquired, passive
Trends in drug resistance
Actions to fight resistance
Bacterial persistence
Antibiotic sensitivity
Consequences of antibiotic resistance
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-

Fundamentals of emergency management,
Psychological impact management,
Resource management,
Preparedness and risk reduction,
Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-106.1	Learn about the patient safety concepts and the core elements of a culture of patient safety
CO2	BMLS-106.2	Understand the patient safety processes, including the reporting of adverse events
CO3	BMLS-106.3	Recognize and respond to appropriately to potential and actual unsafe situations;
CO4	BMLS-106.4	Engage in reflective practice to identify the potential risks presented by one's own daily practice and ways to minimize those risks

Suggested readings:

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

BMLS-107: 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 isrelevant 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-107.1	Learn the basic terminology of subject
CO2	BMLS107.2	Understanding the basic purpose of profession, professional ethics and various moral and social issues.
CO3	BMLS-107.3	Learn about professional Ethical values and contemporary issues
CO4	BMLS-107.4	Acquiring knowledge of various roles of medicals n applying ethical principles at various professional levels

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 VidyaekParichay, 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.

BMLS-108: Environmental Science

Rationale:

The student will be made aware of theenvironment 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

   Solid waste management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

   Disaster management: Floods, earthquake, cyclone and landslides.
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.

   Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

   Case studies, Wasteland reclamation.

   Consumerism and waste products. Environment Protection Act, Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

   Human Population and the Environment, Population growth, variation among nations. Population explosion–Family Welfare Programme. Environment and humanhealth, 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:

   Microbiology
   Biochemistry
   Histopathology
   Haematology
8. Clinical laboratory hazards to the environment from the following and means to prevent:

   Infectious material
   Toxic Chemicals
   Radioactive Material
   Other miscellaneous wastes

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-108.1	Study the intellectual and methodological tools to understand and address the crucial current environmental issues.
CO2	BMLS-108.2	Understand and create environmental ethics and raise people's awareness of the importance of environmental protection and biodiversity
CO3	BMLS-108.3	Apply the knowledge to understand the the impact of individuals, society on significant environmental issues.
CO4	BMLS-108.4	Understanding of proper use of skills and analytical tools needed to face the environmental issues

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 Cunninghan, 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.

Elements of environment Eng. by Dugga

BMLS-109: Principals of Management with special reference to Medical LaboratoryScience (MLS) Management:

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

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

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
   Duty to the patient
   Duty to colleagues and other professionals
   Duty to the society
2. Good Laboratory Practice (GLP) Regulations and Accreditation
   Introduction to Basics of GLP and Accreditation
   Aims of GLP and Accreditation
   Advantages of Accreditation
   Brief knowledge about National and International Agencies for clinical laboratory accreditation
3. Awareness / Safety in a clinical laboratory
   General safety precautions
   HIV: pre- and post-exposure guidelines
   Hepatitis B & C: pre- and post-exposure guidelines
   Drug Resistant Tuberculosis
4. Patient management for clinical samples collection, transportation and preservation
5. Sample accountability
   Purpose of accountability
   Methods of accountability
6. Sample analysis
   Introduction
   Factors affecting sample analysis
7. Reporting results

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

8. Quality Management system
   Introduction
   Quality assurance
   Quality control system
   Internal and External quality control
9. Biomedical waste management in a clinical laboratory
10. Introduction and importance of calibration and Validation of Clinical Laboratory instruments
11. Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management
    Introduction
    Functions of a laboratory management system
    Standards for laboratory management system
    Introduction and awareness of financial management in a clinical laboratory
12. Ethics in Medical laboratory Practice
    Understanding the term ‗Ethics'
    Ethics in relation to the following:
    Pre-Examination procedures
    Examination procedures
    Reporting of results
    Preserving medical records
    Access to Medical laboratory Records
13. Procurement of equipment and Inventory Control
    Audit in a Medical Laboratory
    Introduction and Importance
    Responsibility
    Planning
    Horizontal, Vertical and Test audit
    Frequency of audit
    Documentation

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-109.1	Understand and evaluate key theoretical approaches used in the medical lab field
CO2	BMLS-109.2	To understand the planning process in the organization
CO3	BMLS- 109.3	Able to understanding of managerial functions like planning, and have same basic knowledge on international aspect of management
CO4	BMLS-109.4	To analyze the isolate issues and formulate best control methods

Suggested readings:

1. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, RachnaAgarwal, Sujata Chaturvedi and Rajiv Thakur

BMLS-110: Community Orientation and Clinical Visit

The objective of this particular section of the foundation course is to sensitize potential learnerswith essential knowledge; this will lay a sound foundation for their learning across the under- graduate program and across their career. Innovative teaching methods should be used to ensurethe students' attention and make them more receptive, such as group activities, interactive fora,role plays and clinical bed-side demonstrations. [29]

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.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-110.1	Understand and evaluate key theoretical approaches used in the medical lab field
CO2	BMLS-110.2	Able to know various principles of clinics
CO3	BMLS- 110.3	To understand various activites of hospitals
CO4	BMLS-110.4	Using the patient's history, physical exam, laboratory and imaging results to construct appropriate differential diagnoses

BMLS-111: Basic computers and Information Science-Practical

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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-111.1	Students will have knowledge about the basic hardware system of computer and laptop.
CO2	BMLS-111.2	Learners will able to use Microsoft office
CO3	BMLS-111.3	They will be able to install and use various software.
CO4	BMLS-111.4	Learners will be able to get clerical and data entry jobs.

BMLS-112: Communication and Soft Skills-Practical

1. Précis writing and simple passage from a prescribed text books. Atleast100 words should be chosen and few questions from the passage may be said to answer.
2. To practice all forms communication i.e. drafting report, agenda notes, précis writing, telegram, circular, representations, press, release, telephonic communication, practice of writing resume and writing application of employment.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-112.1	Understand and evaluate key theoretical approaches used in the medical lab field .
CO2	BMLS-112.2	Able to find, use, and evaluate primary academic writing associated with the communication discipline
CO3	BMLS-112.3	Able to communicate effectively orally and in writing
CO4	BMLS-112.4	To develop analytical, management and interpersonal skills, together with the technical knowledge of the work in the medical lab.

BMLS-113: Medical Terminology, Record keeping (including anatomical terms) andOrientation to Medical Laboratory Science (MLS)-Practical

1. General discussion on Medical Terminology and understanding basics of various diseases.
2. Coding
3. Assembling of patient files
4. Sensitization on career opportunities and role of MLS in Hospital Care
5. Visit to working;
   Microbiology
   Haematology
   Biochemistry and
   Histopathology laboratories

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-113.1	Understanding the basic importance of medical terms into their component parts
CO2	BMLS-113.2	Identify combining forms, prefixes, suffixes and terminology associated with each of the body systems.
CO3	BMLS-113.3	Basic knowledge of need and requirements of records in hospitals.
CO4	BMLS-113.4	Understand the importance and types of medical records along with its management

BMLS-114: Introduction to Quality and Patient safety (including Basic emergency careand life support skills, Infection prevention and control, Biomedical waste management,Disaster management and Antibiotic resistance)-Practical

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 onairways 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. Incenerator, 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;
   Resource management,
   Preparedness and risk reduction,

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-114.1	Learn about the patient safety concepts and the core elements of a culture of patient safety
CO2	BMLS-114.2	Understand the patient safety processes, including the reporting of adverse events
CO3	BMLS-114.3	Recognize and respond to appropriately to potential and actual unsafe situations;
CO4	BMLS-114.4	Engage in reflective practice to identify the potential risks presented by one's own daily practice and ways to minimize those risks

BMLS-115: Environmental Science-Practical

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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-115.1	Study the intellectual and methodological tools to understand and address the crucial current environmental issues.
CO2	BMLS-115.2	Understand and create environmental ethics and raise people's awareness of the importance of environmental protection and biodiversity
CO3	BMLS-115.3	Apply the knowledge to understand the the impact of individuals, society on significant environmental issues.
CO4	BMLS-115.4	Understanding of proper use of skills and analytical tools needed to face the environmental issues

BMLS-116: Principals of Management with special reference to Medical LaboratoryScience (MLS) Management: Practical

1. Clinical sample collection e.g.
   Blood
   Urine
   Stool
   Saliva
   Sputum
   Semen analysis
2. Sample accountability
   Labeling of sample
   Making entries in Laboratory records
3. Reporting results
   Basic format of a test report
   Release of examination results
   Alteration in reports
4. Quality Management system
   Quality assurance
   Internal and External quality control
   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:
   Pre-Examination procedures
   Examination procedures
   Reporting of results
   Preserving medical records
   Access to medical laboratory records
8. Audit in a Medical Laboratory -Documentation

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-116.1	Understand and evaluate key theoretical approaches used in the medical lab field
CO2	BMLS-116.2	To understand the planning process in the organization
CO3	BMLS- 116.3	Able to understanding of managerial functions like planning, and have same basic knowledge on international aspect of management
CO4	BMLS-116.4	To analyze the isolate issues and formulate best control methods

SEMESTER-II

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 laband biomedical waste management.

1. Introduction to Medical Microbiology:

Definition, History
Host - Microbe relationship

2. Safety measures in Clinical Microbiology
3. Glassware used in Clinical Microbiology Laboratory:
   Introduction
   Care and handling of glassware
   Cleaning of glassware
   Equipment used in clinical Microbiology Laboratory:
   Introduction
   Care and maintenance including calibration
4. Microscopy
   Introduction and history
   Types, principle and operation mechanism of following microscopes
   Light microscope
   DGI
   Fluorescent
   Phase contrast
   Electron microscope: Transmission/ Scanning
5. Sterilization:
   Definition
   Types and principles of sterilization methods
   Heat (dry heat, moist heat with special Reference to autoclave)
   Radiation
   Filtration
   Efficiency testing to various sterilizers
6. Antiseptics and disinfectants:
   Definition.
   Types and properties
   Mode of action - Uses of various disinfectants
   Precautions while using the disinfectants - Qualities of a good disinfectant
   Testing efficiency of various disinfectants
7. Biomedical waste management in a Medical Microbiology laboratory:
   Types of the waste generated – Segregation – Treatment – Disposal
8. General characteristics & classification of Microbes: (Bacteria &fungi)
   Classification of microbes with special reference to prokaryotes & eukaryotes
   Morphological classification of bacteria
   Bacterial anatomy (Bacterial cell structures)
9. Growth and Nutrition of Microbes:
   General nutritional & other requirements of the bacteria

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

10. Culture media:
    Introduction
    Classification of culture media (Example & Uses) solid media, liquid media, semisolid, Media, routine/synthetic/defined media, basal media, enriched, enrichment, Selectivedifferential media, sugar fermentation media, transport media, preservation media and anaerobic culture media
    Quality control in culture media
    Automation in culture media preparation
11. Aerobic & anaerobic culture methods:
    Concepts
    Methods Used for aerobic cultures
    Methods used for anaerobic cultures
12. Introductions to Immunology
    Immunity
    Antigens and Antibodies
13. Care & handling of laboratory animals:
    Introduction
    General care & handling
    Ethics & legality in use of laboratory animals

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-201.1	Study the growth and control of microbes as well as different bacteriological techniques involved in microbiology.
CO2	BMLS-201.2	Understand about the different cell organelles of microorganisms and their detailed functions.
CO3	BMLS-201.3	Apply the knowledge to understand the microbial physiology and to identify the microorganisms.
CO4	BMLS-201.4	Analyze the microorganisms on basis of appearance and function.

Suggested Readings

1. Practical Medical Microbiology by Mackie and McCartney
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. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Cheesbrough

Text book of Microbiology by Prescott

BMLS-202: Basic Haematology

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

1. Introduction to Haematology
   Definition
   Importance
   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)
   Erythropoiesis
   Leucopoiesis
   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
    Internal and external quality control including reference preparation
    Routine quality assurance protocol
    Statistical analysis i.e. Standard deviation, Co-efficient of variation, accuracy and precision

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-202.1	Learn about the blood
CO2	BMLS-202.2	Understand the composition of blood and different types with its function
CO3	BMLS-202.3	Estimate the ways to know the different components of blood
CO4	BMLS-202.4	Analyze different blood cells

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-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
   Role of Medical lab Technologist
   Ethics and responsibility
   Safety measures
   First aid
2. Cleaning and care of general laboratory glass ware and equipment
   Steps involved in cleaning soda lime glass
   Steps involved in cleaning borosil glass
   Preparation of chromic acid solution
   Storage
3. Distilled water
   Method of preparation of distilled water
   Type of water distillation plants
   Storage of distilled water
4. Units of Measurement.
   S.I unit and CGS units
   Conversion
   Strength, molecular weight, equivalent weight
   Normality, Molarity, Molality
   Numerical
5. Calibration of volumetric apparatus
   Flask
   Pipettes
   Burettes
   Cylinders
6. Analytical balance
   Principle
   Working
   Maintenance
7. Concept of pH
   Definition
   Henderson Hassel batch equation
   Pka value
   pH indicator
   Methods of measurement of pH
   pH paper
   pH meter
   Principle, working, maintenance and calibration of pH meter

8. Volumetric analysis
   Normal and molar solutions
   Standard solutions
   Preparation of reagents
   Storage of chemicals
9. Osmosis
   Definition
   Types of osmosis
   Factors affecting osmotic pressure
   Vant Hoff's equation
   Applications of osmosis
   Dialysis

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-203.1	Learn about the different Glassware used in lab
CO2	BMLS-203.2	Understand the different Apparatus , units, equipments
CO3	BMLS-203.3	Know about different volumetric analysis
CO4	BMLS-203.4	Calibration of glasswares

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-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 willdevelop an understanding of the structure and function of organs and organ systems in normalhuman body.

1. Introduction to human Anatomy and Physiology
2. Cell and cell organelles
   Structure and classification
   Function
   Cell division (Mitosis and Meiosis)
3. Tissues
   Definition
   Classification with structure and Functions
   Epithelial tissues

Connective tissues
Muscular tissues
Nervous tissue

4. Blood
   Composition
   Function of blood
5. Muscular skeletal system
   Introduction
   Classification
   Structure and function of skeletal system, muscles and joints
   Various movements of body

1. Respiratory system
   Introduction
   Structure
   Function
   Mechanism of breathing and respiration
   Various terms involved in respiratory System
   Vital capacity
   Total Volume
   Reserve volume
   Total lung capacity
2. Cardiovascular system
   Anatomy and physiology of heart
   Blood circulation
   Arteries and veins
   Conductive system of heart
   Cardiac cycle
   Introduction to ECG
3. Lymphatic system
   Introduction
   Structure and function
   Lymph nodes
   Spleen
   Thymus gland, Tonsils
4. Structure and function of sense organ
   Eye
   Ear
   Nose
   Tongue
5. Respiratory system
   Introduction
   Structure
   Function
   Mechanism of breathing and respiration
   Various terms involved in respiratory System
   Vital capacity
   Total Volume
   Reserve volume
   Total lung capacity

6. Cardiovascular system
   Anatomy and physiology of heart
   Blood circulation
   Arteries and veins
   Conductive system of heart
   Cardiac cycle
   Introduction to ECG
7. Lymphatic system
   Introduction
   Structure and function
   Lymph nodes
   Spleen
   Thymus gland, Tonsils
8. Structure and function of sense organ
   Eye
   Ear
   Nose
   Tongue
9. 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
10. 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
11. Liver: structure and function
12. Urinarysystem:Mainparts,Structure&functionofkidney,structureof nephron, physiology of excretion & urine formation,urine,additional excretory organs
13. Genital system: Structure of male and female reproductive system, Gametogenesis in male & female, menstrual cycle. Placenta and extra embryonic membranes.
14. Nervous system: Parts, function & structure; brain, spinal cord, spinal & cranial nerves; all & none principle, role of neurotransmitters in transmission of nerve impulse
15. Endocrine system: Endocrine & exocrine glands, their location, structure & functions

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-204.1	Learn the basic terminology of subject
CO2	BMLS-204.2	Understand about different cells, tissues and blood
CO3	BMLS-204.3	Know about anatomy and physiology of human body
CO4	BMLS-204.4	Develop understanding of structure and function of different organ sytems

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

BMLS-205: 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-205.1	Know the Different Microbiological Instruments and chemicals used in laboratory
CO2	BMLS-205.2	Understand the working of various instruments
CO3	BMLS-205.3	Preparation of different culture media
CO4	BMLS-205.4	Identification of different microbies

BMLS-206 Basic Haematology – Practical

1. Preparation of various anticoagulants :
   EDTA
   Sodium Citrate,
   Oxalate with Fluoride
2. Collection of blood sample for various Lab Investigations
3. Familiarization and working of routine Haematology Lab. Instruments
   Microscopes
   Haemocytometers
   Colorimeter
   Spectrophotometer
   Glass pipettes & Auto pipettes
   Glassware
   Sahli‘s Apparatus
4. Identification of Normal blood cells

5. Urine Analysis:
   Routine biochemistry of Urine for:
   pH
   Specific Gravity
   Glucose
   Ketones
   Bilirubin
   Albumin
   Microscopic Examination of Urine

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-206.1	Know the various haematological lab instruments
CO2	BMLS-206.2	Practice to Collect blood
CO3	BMLS-206.3	Preparation of different anticoagulants and chemicals
CO4	BMLS-206.4	Identification of different blood cells

BMLS-207: 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 H2SO4
7. To prepare 0.2 Molar Sodium carbonate solution.
8. Demonstration of osmosis and dialysis.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-207.1	Know about various glassware including volumetric and non volumetric
CO2	BMLS-207.2	Understand about different cleaning agents and how to clean glasswares
CO3	BMLS-207.3	Learn about the molar solution concept
CO4	BMLS-207.4	Apply the molar solution concept for preparation of different concentrations of solution

BMLS-208: 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-208.1	Learn the basic terminology of subject
CO2	BMLS-208.2	Understand about different cells, tissues and blood
CO3	BMLS-208.3	Know about anatomy and physiology of human body
CO4	BMLS-208.4	Develop understanding of structure and function of different organ sytems

SEMESTER-III

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
   Instruments used to seed culture media
   Culture procedures – seeding a plate
2. Staining techniques in bacteriology
   Significance of staining in bacteriology
   Principle, Reagent preparation, procedures and interpretation of the following
   Simple staining
   Negative staining
   Gram stain
   Albert's stain
   Neisser's stain
   Ziehl –Neelsen staining
   Capsule staining
   Flagella staining
   Spore staining
   Fontana stain for spirochetes
3. Principle, procedures and interpretation of the following biochemical tests for identification of different bacteria.
   Catalase
   Coagulase
   Indole
   Methyl Red
   VogesProskauer
   Urease
   Citrate
   Oxidase
   TSIA
   Nitrate reduction
   Carbohydrate fermentation
   Huge and Leifson
   Bile solubility
   H 2 S production
   Demonstration of motility
   Decarboxylases
   CAMP
   Hippurate hydrolysis
   Nagler's reaction
   Cholera-red reaction
4. Definition, Classification, Various characteristics (morphological, cultural and

biochemical), pathogenesis and laboratory diagnosis of the following bacteria
Staphylococcus
Streptococcus
Pneumococcus
Neisseria gonorrhea and Neisseria meningitis
Haemophilis
Corynebacterium
Enterobacteriaceae: Escherichia coli, Klebsiella, Citrobacter, Enterobacter, Proteus, Salmonella, Shigella, Yersinia enterocolitica and Yersinia pestis
Vibrio, Aeromones and Plesiomonas
Clostridia of wound infection
Mycobacterium tuberculosis complex, Atypical Mycobacteria and M. leprae
Spirochetes – Treponema, Borrellia and leptospira
Bordetella and brucella
Mycoplasma and Ureaplasma
Rickettsia
Chlamydia
Actinomyces
Pseudomonas and Burkholderia
Brief introduction about non sporing anaerobic cocci and bacilli

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-301.1	Study about various microbes, classification and identification with various methods
CO2	BMLS-301.2	Learn different staining procedure for bacteriological study
CO3	BMLS-301.3	Study about various biochemical testing procedures
CO4	BMLS-301.4	Apply the knowledge to understand the microbial physiology and to identify the microorganisms.

Suggested Readings:

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

BMLS-302: Basics of Hematological Diseases

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

1. Anemia
   Introduction
   Classification
   Microcytic hypochromic anemia
   Macrocytic anemia
   Normocytic normochromic anemia
2. Quantitative disorders of Leukocytes Cause and significance
   Granulocytic and Monocytic Disorders
   Lymphocytic Disorders
3. Morphologic Alterations in Neutrophils
   Toxic granulation
   Cytoplasmic vacuoles
   Döhle bodies
   May–Hegglin anomaly
   Alder–Reilly anomaly
   Pelger–Huët anomaly
   Chédiak–Higashi syndrome
4. Bleeding disorders
   Introduction Causes of bleeding disorders
   Vascular defect
   Platelet defect
   Factor deficiency
   Inhibitors
   Hyper fibrinolysis
   Types of bleeding disorders
   Inherited bleeding disorders
   Acquired bleeding disorders
5. Thrombosis
   Introduction
   Causes of thrombosis
6. Monitoring of Anticoagulants
   Oral anticoagulants by INR
   Heparin

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-302.1	Students will have great knowledge about morphological changes in erythrocytes and leukocytes.
CO2	BMLS-302.2	Identification of variants in HB, TLC, PCV and platelets and automation hematology
CO3	BMLS-302.3	Learners will be able to perform various coagulation tests related to haemostasis and fibrinolysis.
CO4	BMLS-302.4	Ablity to take blood sample and Can perform test for the identification of anemias.

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 (20thedition) 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-303: Biochemical Metabolism

Rationale: This subject shall give information about all the major metabolic pathways occurringin 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
   Introduction, Importance and Classification
   Digestion and Absorption
   Metabolism: - Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenolysis, Glycogenesis
   Disorders of carbohydrate metabolism.
2. Protein Metabolism
   Introduction, Importance and classification
   Important properties of proteins
   Digestion & absorption of Proteins
   Protein synthesis
   Metabolism of proteins
   Disorders of protein metabolism and Urea Cycle
3. Lipid
   Introduction & Classification
   Digestion & absorption of fats
   Lipoproteins
   Fatty acid biosynthesis & fatty acid oxidation
4. Nucleic Acid
   Introduction
   Functions of Nucleic acid
   Functions of energy carriers
5. Enzymes
   Introductions, Importance & Classifications
   Properties of enzymes
   Mechanism of enzyme action
   Factors affecting enzyme action
   Enzyme kinetics & enzyme inhibiters

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-303.1	Study the different biomolecules
CO2	BMLS-303.2	Understand the metabolism of different biomolecules
CO3	BMLS-303.3	They study the influence and role of structure in reactivity of biomolecules
CO4	BMLS-303.4	Develop critical thinking about the functioning of biomolecules.

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-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
   Liver – hepatitis, liver failure, cirrhosis.
   Pancreas- pancreatitis.
   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:
   Pituitary: Hyper & Hypo secretions
   Thyroid: Goiter
   Adrenal: Cushing Syndrome, Addison Disease
   Pancreas: Diabetes
10. Sense Organs:
    Ear: Otitis
    Eye: Cataract

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-304.1	Learn about various systems of body
CO2	BMLS-304.2	Understand about the different dieases related to different oragn systems
CO3	BMLS-304.3	Students will have knowledge about various tests for the identification of disorders.
CO4	BMLS-304.4	Implementation of this learning in finding to different diseases

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-305: 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 Gram stain

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-305.1	Study about various microbes, classification and identification with various methods
CO2	BMLS-305.2	Learn different staining procedure for bacteriological study
CO3	BMLS-305.3	Study about various biochemical testing procedures
CO4	BMLS-305.4	Apply the knowledge to understand the microbial physiology and to identify the microorganisms.

BMLS-306: 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
    - Albert stain
    - Neisser‘s staining
    - Z-N staining
    - Capsule staining
    - Demonstration of flagella by staining methods
    - Spore staining
    - To demonstrate spirochetes by Fontana staining procedure
7. To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria:
    - Catalase
    - Coagulase
    - Indole
    - Methyl Red (MR)
    - VogesProskauer (VP)
    - Urease
    - Citrate
    - Oxidase
    - TSIA
    - Nitrate reduction
    - Carbohydrate fermentation
    - Huge and Leifson
    - Bile solubility
    - H2S production
    - Demonstration and motility
    - Decarboxylases
    - CAMP
    - Hippurate hydrolysis
    - Nagler‘s reaction
8. To demonstrate various characteristics (morphological, cultural and biochemical) of bacteria commonly isolated from clinical samples i.e.
    - Staphylococcus
    - Streptococcus
    - Corynebacterium
    - Escherichia coli
    - Klebsiella
    - Citrobacter
    - Enterobacter
    - Proteus
    - Salmonella
    - Shigella

- Vibrio cholera
- Mycobacterium tuberculosis
- Pseudomonas

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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-306.1	Students will have great knowledge about morphological changes in erythrocytes and leukocytes.
CO2	BMLS-306.2	Identification of variants in HB, TLC, PCV and platelets and automation hematology
CO3	BMLS-306.3	Learners will be able to perform various coagulation tests related to haemostasis and fibrinolysis.
CO4	BMLS-306.4	Ablity to take blood sample and Can perform test for the identification of anemias.

BMLS-307: 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-307.1	Study the different biomolecules
CO2	BMLS-307.2	Preparation of different chemicals
CO3	BMLS-307.3	Presence of different biomolecules with different test
CO4	BMLS-307.4	Identification of biomolecules

BMLS-308 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-308.1	Learn about various systems of body
CO2	BMLS-308.2	Understand about the different dieases related to different oragn systems
CO3	BMLS-308.3	Students will have knowledge about various tests for the identification of disorders.
CO4	BMLS-308.4	Implementation of this learning in finding to different diseases

SEMESTER-IV

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:

Septicemia and bacteremia

1. Sterility testing of I/v fluids

Collection, transportation and processing of I/v fluids for bacterial contamination
Recording the result and interpretation

2. Nosocomial Infection:

Introduction, sources and types of nosocomial infections.
Surveillance of hospital environment for microbial load.

Upper Respiratory tract infections
Lower respiratory tract infections
Wound, skin, and deep sepsis
Urinary tract infections
Genital Tract infections
Meningitis
Gastro intestinal infections
Enteric fever
Tuberculosis (Pulmonary and Extra-pulmonary)
Pyrexia of unknown origin

3. Antibiotic susceptibility testing in bacteriology

Definition of antibiotics
Culture medium used for Antibiotic susceptibility testing
Preparation and standardization of inoculum
Control bacterial strains
Choice of antibiotics
MIC and MBC: Concepts and methods for determination
Various methods of Antibiotic susceptibility testing with special reference to Stokesand Kirby-Bauer method

4. Basics of Nucleic acid techniques in diagnostic microbiology with special reference to Polymerase chain reaction (PCR)
5. Automation in bacterial culture detection and antimicrobial susceptibility testing: Principles and importance.
6. Bacteriological examination of water, milk, food and air

Examination of water
Collection and transportation of water sample
Presumptive coliform count
Eijkman test
Introduction and importance of other bacteria considered as indicators of fecal contamination

Membrane filtration tests
Interpretation of results
Examination of Milk and milk products
Basic Concepts regarding gradation of milk
Various tests for Bacteriological examination of milk
Examination of food articles
Basic Concepts regarding classification of food like frozen food, canned food, raw food, cooked food etc.
Various tests for Bacteriological examination with special reference to food poisoning bacteria
Examination of Air
Significance of air bacteriology in healthcare facilities
Settle plate method
Types of air sampling instruments
Collection processing and reporting of an air sample
Role of microbiology laboratory in control of nosocomial infections

7. Epidemiological markers:
Introduction
Types
Serotyping
Phage typing and
Bacteriocin typing
8. Preservation methods for microbes
Basic concepts of preservation of microbes
Why do we need to preserve bacteria?
Principle and procedures of various short term and long term preservation methodswith special reference to Lyophilization

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-401.1	Learners will be able to make Laboratory strategies in the diagnosis of various systemic bacterial infection.
CO2	BMLS-401.2	Study about Antibiotic susceptibility testing in bacteriology with various methods
CO3	BMLS-401.3	Study about bacteriological examination of water, milk, food and air with various diagnostic methods and with special reference to different bacteria.
CO4	BMLS-401.4	Learners will have knowledge about source and types of Nosocomial infection, epidemiological markers and preservation methods for various microbes.

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
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 SumathiMurlidhar

BMLS-402: Applied Haematology-I

Rationale: Thestudentswillbemadeawareof the methodsofestimating different componentsofblood. Students will learnthe basic concepts of staining and coagulation inHaematologylaboratory.

1. Haemoglobinometry: Different methods to measure Haemoglobin with merits and demerits
2. Haemocytometery: Introduction, Principle, Reagent preparation, procedure, errors involved and means to minimize errors.
   RBC Count,
   Totalleucocytescount(TLC)
   PlateletCount.
   AbsoluteEosinophilcount
3. Principle mechanism and different methods with merit and demerits for the measuring ErythrocyteSedimentationRate(ESR) and its significance
4. Different methods with merit and demerits for packedcellvolume/Haematocritvalue
5. Preparationofblood films
   Types, Methodsofpreparation (Thick andthinsmear/film) and utility
6. StainingtechniquesinHaematology(Romanowsky‘sstains):Principle, composition,preparationofstainingreagentsandprocedureofthefollowing
   Giemsa‘sstain
   Leishman‘sstain
   Wright‘sstain
   Field‘s stain
   JSBstain.
7. Differentialleucocytescount(DLC)
8. Normal and absolute values in Haematology
9. Physiologicalvariations inHb,PCV,TLCandPlatelets
10. Macroscopic and microscopicexaminationof seminalfluid
11. ExaminationofCSF andotherbody fluids for cytologyi.e. pleural,peritonealand synovial fluid etc.
12. Preparation of Reagents for coagulation studies:
    M/40 Calcium chloride
    Brain Thromboplastin
    Cephalin
    Adsorbed Plasma
13. Screening Tests for coagulation Studies and their significance

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-402.1	Students will have great knowledge about morphological changes in erythrocytes and leukocytes.
CO2	BMLS-402.2	Identification of variants in HB, TLC, PCV and platelets and automation hematology
CO3	BMLS-402.3	Learners will be able to perform various coagulation tests related to haemostasis and fibrinolysis.
CO4	BMLS-402.4	Ablity to take blood sample and Can perform test for the identification of anemias.

SuggestedReadings:

1. Textbook ofMedicalLaboratoryTechnologyby PrafulB. Godkar
2. MedicallaboratoryTechnologyby K.L.Mukherjee Volume-I
3. PracticalHaematology by J.B. Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20thedition)by John BernardHenry
5. Atlasof Haematologyby G.A.McDonald
6. De Gruchy's Clinical Haematology in medical practice

BMLS-403: Analytical Clinical Biochemistry

Rationale

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

1. Spectrophotometry and colorimetry
   Introduction
   Theory of spectrophotometry and colorimetry
   Lambert`s law and Beer`s law
   Applications of colorimetry and spectrophotometry
2. Photometry
   Introduction
   General principles of flame photometry
   Limitations of flame photometry
   Instrumentation
   Applications of flame photometry
   Atomic absorption spectroscopy – Principle & applications
3. Chromatography
   Introduction
   Types of chromatography
   Paper Chromatography: Introduction, principle, types, details for qualitative and quantitative analysis, application
   Thin layer chromatography: Introduction, experimental techniques, application of TLC, limitations, High performance thin layer chromatography
   Column chromatography: Introduction, principle column efficiency, application of column chromatography
   Gas chromatography: Introduction principle, instrumentation, application
   Ion exchange chromatography: Introduction, Definition and principle, cation and anion exchangers, application
   Gel Chromatography: Introduction Principle and method, application and advantages
4. Electrophoresis:
   Introduction
   Principle
   Instrumentation
   Applications
   Types of electrophoresis
   Paper electrophoresis
   Gel electrophoresis

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-403.1	Learner will gain knowledge about various instruments used for the analysis of different bio-molecules.
CO2	BMLS-403.2	By using spectrophotometer, colorimeter and photometric techniques students will be able to perform different test.
CO3	BMLS-403.3	Study distinct Chromatography techniques, their uses and methodology.
CO4	BMLS-403.4	Students will be able to use electrophoretic techniques and spectroscopic techniques.

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-404: Applied Histopathology-I

Rationale: In this Section, students will be made aware of terminology used inhistotechnology, various instruments and the rmaintenance and also learn the processing of various samples for histopathological investigations.

1. Introduction to Histotechnology
2. Compound microscope:
   Optical system, magnification and maintenance
   Microscopy:
   Working principle
   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
   Simple fixatives
   Compound fixatives
   Special fixatives for demonstration of various tissue elements
9. Decalcification
   Criteria of a good decalcification agent
   Technique of decalcification followed with selection of tissue, fixation, anddecalcification, neutralization of acid and thorough washing
   Various types of decalcifying fluids: Organic & Inorganic Acid, chelating agents, Useof Ion-

exchange resigns and Electrophoretic decalcification and treatment of hard tissueswhich are not calcified

10. Processing of various tissues for histological examination
Procedure followed by Dehydration, Clearing, Infiltration and routine timingschedule for manual or automatic tissue processing.
Components & principles of various types of automatic tissue
Processors
Embedding:
Definition
Various types of embedding media
11. Section Cutting
Introduction regarding equipment used for sectioning
Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping, varioustypes of microtome and their applications
Freezing Microtome and various types of Cryostats.
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
Theory of Staining, Classifications of Dyes, Principles of Dye Chemistry
Stains and Dyes and their uses
Types of Stains, Chemical Staining Action, Mordants and Accentuators,Metachromasia
Use of Controls in Staining Procedures
Preparation of Stains, solvents, aniline water and buffers etc.
Commonly used mountants in histotechnology lab
General Staining Procedures for Paraffin Infiltrated and Embedded tissue
Nuclear Stains and Cytoplasmic stains
Equipment and Procedure for manual Staining and Automatic Staining Technique
Mounting of Cover Slips, Labeling and Cataloguing the Slides
13. Routine Staining Procedures
Haematoxylin and Eosin Staining, various types of Haematoxylins 13.2Mallory‘s Phosphotungstic Acid Haematoxylin (PTAH)

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-404.1	Study the various equipments used in histopatholgy Laboratory.
CO2	BMLS-404.2	Understand the routine working, care and maintance of Microtomes.
CO3	BMLS-404.3	Understand the basic procedures of the Honing and stropping techniques,different types of specimen used in Histotechnological specimens and collection and precessing of Histopathology specimens.
CO4	BMLS-404.4	Understand the proper use and handling of common laboratory equipments used in histopathology laboratory.

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

BMLS-405: 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:
   Blood
   Throat swab
   Sputum
   Pus
   Urine
   Stool for Salmonella, Shigella and Vibrio cholerae
   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
   Introduction and terms used
   Preparation and standardization of inoculum
   To demonstrate reference bacterial strains
   To determine MIC and MBC of known bacteria against a known antibiotic
   To perform antibiotic susceptibility testing of clinical isolates by using
   Stokes method
   Kirby-Bauer method
7. Collection, transportation and processing of following articles for bacteriological examination:
   Water
   Milk
   Food and
   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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-405.1	Students will be able to Inoculate different samples on culture media and identification of pure culture.
CO2	BMLS-405.2	Laboratory strategies in the diagnosis of various systemic bacterial infection.
CO3	BMLS-405.3	Learners can perform Antibiotic susceptibility testing in bacteriology with various methods
CO4	BMLS-405.4	Study about bacteriological examination of water, milk, food and air with various diagnostic methods and with special reference to different bacteria.

BMLS-406: Applied Haematology-I – Practical

1. HbEstimation
   Sahli'smethod
   Cyanmethahaemoglobinmethod
   Oxyhaemoglobinmethod
2. Totalleukocytecount
3. Plateletscount
4. AbsoluteEosinophil count
5. Preparationof smearandstainingwithGiemsaandLeishmanstain.
6. ESR(WintrobeandWestergrenmethod)
7. Packedcellvolume(Macro&Micro)
8. CytologicalexaminationofCSF andotherbody fluids
9. Physical andMicroscopic examinationof seminalfluidincludingsperm count
10. Perform normal DLC
11. Preparation of M/40 Calcium chloride
    Brain thromboplastin and standardization
    Cephalin
    Adsorbed plasma
12. Perform BT, CT, Hess test, PT and APTT

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-406.1	Learners will be able to perform various tests for the identification of red cell abnormalities.
CO2	BMLS-406.2	Learners will be able to perform various tests for the identification of leukocyte abnormalities.
CO3	BMLS-406.3	Students will have knowledge about various tests for the identification of coagulation disorders.
CO4	BMLS- 406.4	Students can collect blood sample and can perform various test for the identification of anemias.

BMLS-407: 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.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-407.1	Learner will gain knowledge about various instruments used for the analysis of different bio-molecules.
CO2	BMLS-407.2	By using spectrophotometer, colorimeter and photometric techniques students will be able to perform different test.
CO3	BMLS-407.3	Study distinct Chromatography techniques, their uses and methodology.
CO4	BMLS-407.4	Students will be able to use electrophoretic techniques and spectroscopic techniques.

BMLS-408: 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
   - Helly‘s fluid
   - Zenker‘s fluid
   - Bouin‘s fluid
   - Corney‘s fluid
   - 10% Neutral formalin
   - Formal saline
   - Formal acetic acid
   - 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-408.1	Study the various equipments used in histopatholgy Laboratory.

CO2	BMLS-408.2	Understand the routine working, care and maintance of Microtomes.
CO3	BMLS-408.3	Understand the basic procedures of the Honing and stropping techniques,different types of specimen used in Histotechnological specimens and collection and precessing of Histotechnological specimens.
CO4	BMLS-408.4	Understand the proper use and handling of common laboratory equipments used in histotechnology laboratory.

SEMESTER-V

Fifth Semester

BMLS-501: Immunology and Bacterial Serology

Rationale: This section will cover the basic aspects of immunity, antigens, antibodies, variousserological 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
   - Innate
   - Acquired immunity
   - 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
   - Definition
   - Classification
   - General features and mechanisms
   - Applications of various antigen antibody reactions
6. Principle, procedure and applications of under mentioned in Medical Microbiology:
   - Complement fixation test
   - Immuno- fluorescence
   - ELISA
   - SDS-PAGE
   - Western blotting
7. Principle, procedure and interpretation of various serological tests:
   - Widal
   - VDRL
   - ASO
   - CRP
   - Brucella tube agglutination
   - Rose-Waaler
8. Complement system:
   - Definition
   - Basic concepts about its components
   - Complement activation pathways
9. Immune response:
   - Introduction
   - Basic concepts of Humoral and Cellular immune responses
10. Hypersensitivity:
    - Definition
    - Types of hypersensitivity reactions
11. Basic concepts of autoimmunity and brief knowledge about autoimmune diseases
12. Automation in diagnostic serology
13. Vaccines:
    - Definition
    - Types
    - Vaccination schedule
    - Brief knowledge about _Extended programme of immunization‘ (EPI) in India

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-501.1	Study the history,introduction and types of antigens and immunoglobulins.
CO2	BMLS-501.2	Understand about the different types immune response, basic concepts of Humoral and cellular immune response.
CO3	BMLS-501.3	Apply the knowledge to understand the types ,vaccination and brief knowledge about vaccination.
CO4	BMLS-501.4	Analyze the Principles, Procedures and interpretation of various serological tests

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
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-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 learnabout 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:
   Blood cell counter
   Coagulometer
3. Bone marrow examination
   Composition and functions
   Aspiration of bone marrow (Adults and children)
   Processing of aspirated bone marrow (Preparation & staining of smear)
   Brief knowledge about examination of aspirated bone marrow (differential cell counts andcellular ratios)
   Processing and staining of trephine biopsy specimens
4. Red cell anomalies
   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.
   Definition of L.E. cell.
   Demonstration of L.E. cell by various methods.
   Clinical significance.
7. Correction studies for Factor deficiency
8. Quantitative assay of coagulation factors
   Principle

Procedure

9. Screening of inhibitors
   Inhibitors against coagulation factors
   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)

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-502.1	Study the Introduction, classification and Laboratory diagnosis of various types of anemia's.
CO2	BMLS-502.2	Understand about the different types Blood coagulation tests like haemophilia, Von willebrand syndrome Diffuse intravascular coagulation(DIC)Idiopathic thrombocytopenic purpura (ITP)And other miscellaneous disorders
CO3	BMLS-502.3	Apply the knowledge to understand the Bone marrow Aspiration ,its clinical significance and staining procedures.
CO4	BMLS-502.4	Analyze the various staining procedures of Polycythemia Erythrocyte and leucocyte cytochemistry Diagnostic radioisotopes in haematology.

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-503: Applied Clinical Biochemistry–I

Rationale: The students will be taught about Hazards & safety measures in a clinical biochemistrylab, 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:
   Glucose
   Proteins
   Urea
   Uric acid
   Creatinine
   Bilirubin
   Lipids
5. Principles, procedures for estimation & assessment of the following including rrors involved and their corrections
   Sodium, Potassium and Chloride, Iodine
   Calcium, Phosphorous and Phosphates
6. Instruments for detection of Radioactivity
7. Applications of Radioisotopes in clinical biochemistry.
8. Enzyme linked immune sorbent assay

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-503.1	Study the basic biochemical analytical proceduresas well as to get aware of the recent trends in clinical biochemistry Laboratory.
CO2	BMLS-503.2	Understand about the Laboratory management and biochemical techniques.
CO3	BMLS-503.3	Apply the knowledge to understand the Introduction, Principles, procedures , clinical significance, Precautions, normal range, result/interpretation of Sodium, Potassium and Chloride, Iodine.Calcium, Phosphorous and Phosohates tests
CO4	BMLS-503.4	Analyze the Knowledge ofHazards & safety measures in clinical Biochemistry laboratory organization, management and maintenance of records.

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-504: Applied Histopathology-II

Rationale: Students will learn about various staining procedures for demonstration of differentsubstances. 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
   Connective tissue elements, Trichrome staining, muscle fibers, elastic, reticulin fibers,collagen fibers etc.
   Metachromatic staining such as Toludine blue on frozen sections
   Principles of metal impregnation techniques.
   Demonstration and identification of minerals and pigments, removal ofPigments/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:
    working principle and its components
    Processing, embedding and ultra-microtomy
12. Micrometry and Morphometry

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-504.1	Students will learn about the various staining procedures for determination of different substrate
CO2	BMLS-504.2	Understand about special staining procedures, its handling and testing the various histological specimens in addition to cryostat sectionong
CO3	BMLS-504.3	Understanding the basic requirements for Histopathology, collection and processing of tissues and brief knowledge of preparation of solutions and different types of assays
CO4	BMLS-504.4	Analysis of tissues under microscope.

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-505: 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.
   Widal,
   Brucella Tube Agglutination,
   VDRL (including Antigen Preparation),
   ASO (Anti-Streptolysin _O')
   C-Reactive Protein (Latex agglutination)
   Rheumatoid factor (RF) Latex agglutination
   Rose Waaler test,
5. Demonstration of antigen/antibody determination by Immuno fluorescence (IF), Immunodiffusion, precipitation in Agarose gel (Ouchterlony), CCIEP, ELISA, SDS - PAGE and Western blotting.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-505.1	Study the basic Immunology and serology Procedures as well as to get aware of the recent trends in the immunology and serology lab.
CO2	BMLS-505.2	Understand the routine staining procedures like Widal,CRP,ASO ans RA factor tests.
CO3	BMLS-505.3	Understand the basic requirements of the Immunology and serological specimens their collection and processing of specimens.
CO4	BMLS-505.4	Understand the proper use and handling of common laboratory equipments and Glasswares.

BMLS-506: 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:
   Factor VIII
   Factor IX
   Factor VII
   Factor X
   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.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-506.1	Study the various equipments used in haematology Laboratory.
CO2	BMLS-506.2	Understand the Various lab diagnostic tests used for different types of anemia's.
CO3	BMLS-506.3	Understand the basic procedures of the Bone Marrow aspiration.
CO4	BMLS-506.4	Understand the proper use and handling of common laboratory equipments used in haematology Laboratory.

BMLS-507: 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.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-507.1	Study the basic biochemical analytical procedures as well as to get aware of the recent trends in clinical biochemistry.
CO2	BMLS-507.2	Understand the routine biochemical investigations like blood sugar, renal function tests, Liver function tests
CO3	BMLS-507.3	Understanding the basic requirements for the biochemical investigations including different biological specimens, their collection and processing of biochemical estimations and have brief knowledge of preparation of solutions and different types of assays
CO4	BMLS-507.4	Understanding of proper use and handling of common Laboratory Equipment and Glassware in biochemistry lab.

BMLS-508: 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:
    Gram's staining
    AFB staining (Ziehl Neilson's staining) for M. tuberculosis and leprae
    Grocott's stain for fungi
    Schmorl's reaction for reducing substances (melanin)
11. To stain for nucleic acid (DNA and RNA)
    Feulgen Staining
    Methyl Green-Pyronin Staining
    Enzymatic methods

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-508.1	Students will learn about the various staining procedures for determination of different substrate
CO2	BMLS-508.2	Understand about special staining procedures, its handling and testing the various histological specimens in addition to cryostat sectioning
CO3	BMLS-508.3	Understanding the basic requirements for Histopathology, collection and processing of tissues and brief knowledge of preparation of solutions and different types of assays
CO4	BMLS-508.4	Analysis of tissues under microscope.

SEMESTER-VI

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:
   General characteristics of protozoa.
   Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Entamoeba sp.
   Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Intestinal and vaginal flagellates i.e. Giardia, Trichomonas sp.
   Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of blood and tissue flagellates i.e. Plasmodium and Toxoplasmasp.
3. Helminthology/ Helminthic parasites:
   General characteristics of Cestodes, Trematodes and Nematodes
   Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of :

   Taeniasolium and saginata
   Echinococcusgranulosus
   Hymenolepis nana
   Schistosoma haematobium and mansoni
   Fasciola hepatica and buski
   Trichuristrichura
   Trichinellaspirales
   Strongyloidesstercoralis
   Ancylostomaduodenale
   Enterobiusvermicularis
   Ascarislumbricoides
   Wuchereriabancrofti
   Dracunculusmedinensis
4. Diagnostic procedures:
   Examination of Stool for parasites
   For intestinal protozoal infections
   General rules for microscopic examination of stool samples
   Collection of stool samples
   Preparation of material for unstained and stained preparations
   Staining methods i.e. Iodine staining and permanent staining
   For Helminthic infections
   Introduction, direct smear preparation and examination
   Concentration techniques i.e. Flotation and sedimentation techniques
   Egg counting techniques
   Examination of blood for parasites
   Preparation of thin and thick blood film
   Leishman staining
   Examination of thick and thin smear
   Field‘s stain
   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)

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-601.1	Study the growth and control of Parasites as well as different Parasitological techniques involved in Parasitology.
CO2	BMLS-602.2	Understand about the different cell organelles of Parasites and their detailed functions.
CO3	BMLS-603.3	Apply the knowledge to understand the Parasite's physiology and to identify the Parasites.
CO4	BMLS-604.4	Analyze the Parasites on basis of appearance and function.

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-602: Advanced Haematology

Rationale

The students will be made aware of different anemia, Leukemia, chromosomal studies, bleedingdisorders 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
   Hemophilia A, B & Von-Willebrand disease
   DIC
   Platelet disorder (Qualitative and quantitative)
7. Laboratory approach for investigating thrombosis.
8. Using radioisotopes measurement of:
   Blood volume
   Determination of Red cell volume and Plasma volume
   Red cell life span
   Platelet life span
   Radiation hazards and its prevention
   Disposal of radioactive material

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-602.1	Study the various equipments used in haematology Laboratory.
CO2	BMLS-602.2	Understand the Various lab diagnostic tests used for different types of anaemias.
CO3	BMLS-602.3	Understand the basic procedures of the Bone Marrow aspiration.
CO4	BMLS-602.4	Understand the proper use and handling of common laboratory equipments used in haematology Laboratory.

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-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:
   Glucose tolerance test
   Insulin tolerance test
   Xylose excretion test.
3. Gastric analysis.
4. Clearance test for renal function.
5. Qualitative test for:
   Urobilinogens
   Barbiturates
   T3, T4 and TSH
   Ketosteroids
6. Enzymes:
   Principles
   Clinical significance and
   Procedures for estimation
   Acid phosphatase
   Alkaline phosphatase
   Lactate dehydrogenase
   Aspartate transaminase
   Alanine transaminase
   Creatine phosphokinase
7. Qualitative analysis of Renal calculi.
8. Chemical examination of Cerebrospinal fluid.
9. Brief knowledge about rapid techniques in clinical biochemistry

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-603.1	Study the basic biochemical analytical procedures as well as to get aware of the recent trends in clinical biochemistry.
CO2	BMLS-603.2	Understand about the Laboratory Management and Biochemical techniques skills
CO3	BMLS-603.3	Apply the knowledge to understand the the diagnosis of diseases, prognosis and treatment.
CO4	BMLS-603.4	Understand the need, advantages and recent advances of automation in a Clinical biochemistry laboratory

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 Chaterjee&Shinde.
6. Principal of Biochemistry by Lehninger
7. Biochemistry by Voet&Voet
8. Biochemistry by Stryer

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:
   Diagnostic applications
   Demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases
3. Vital staining for Sex Chromatin
4. Aspiration cytology:
   Principle
   Indications & utility of the technique with special emphasis on role ofcytotechnologist in FNAC clinics
5. Exfoliative cytology (Papanicolaou technique for the staining of cervical smears)
   Cervical cytology
   Fluid Cytology
   Urine
   CSF
   Body Fluids (Pleural, Pericardial, Ascitic)
6. Automation in cytology
7. Liquid based cytology: Principles and preparation, Cytocentrifuge, molecular cytology, Cell Block and Immune-cytochemistry

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-604.1	Study the basic Cytopathology procedures as well as to get aware of the recent trends in Cytopathology.
CO2	BMLS-604.2	Understand about the Laboratory Management & Cytopathology techniques skills
CO3	BMLS-604.3	Apply the knowledge to understand the the diagnosis of diseases, prognosis and treatment.
CO4	BMLS-604.4	Understand the need, advantages and recent advances of automation in a Cytopathology laboratory

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-605: Medical Parasitology and Entomology – Practical

1. Routine stool examination for detection of intestinal parasites with concentration methods:
   Saline preparation
   Iodine preparation
   Floatation method
   Centrifugation method
   Formal ether method
   Zinc sulphate method
2. Identification of adult worms from models/slides:
   Tapeworm
   Tapeworm segments
   Ascaris (Round worm)
   Hookworms
   Pinworms
3. Malarial parasite:
   Preparation of thin and thick smears
   Staining of smears
   Examination of smears for malarial parasites (P. vivax and P. falciparum)

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-605.1	Study the basic Parasitology and emtomology related procedures as well as to get aware of the recent trends in them.
CO2	BMLS-605.2	Understand the routine biochemical investigations like Stool examination, and adult worms study.
CO3	BMLS-605.3	Understanding the basic requirements for the Parasitological investigations including different biological specimens, their collection and processing of Parasitological estimations and have brief knowledge of preparation of solutions and different types of assays
CO4	BMLS-605.4	Understanding of proper use and handling of common Laboratory Equipment and Glassware in lab.

BMLS-606: 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.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-606.1	Study the various equipments used in haematology Laboratory.
CO2	BMLS-606.2	Understand the Various lab diagnostic tests used for different types of anaemias.
CO3	BMLS-606.3	Understand the basic procedures of the Bone Marrow aspiration.
CO4	BMLS-606.4	Understand the proper use and handling of common laboratory equipments used in haematology Laboratory.

BMLS-607: 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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-607.1	Study the basic biochemical analytical procedures as well as to get aware of the recent trends in clinical biochemistry.
CO2	BMLS-607.2	Understand the routine biochemical investigations like Uric acid, sugar, thyroid
CO3	BMLS-607.3	Understanding the basic requirements for the biochemical investigations including different biological specimens, their collection and processing of biochemical estimations and have brief knowledge of preparation of solutions and different types of assays
CO4	BMLS-607.4	Identification of test results

BMLS-608: Cytopathology – Practical

1. To perform Papnicolaou‘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 cytospin
6. Should know the various stains used in Cytology lab:‖ May Grunwald Giemsa, H&E, PAS, Grocott‘s.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-607.1	Study the basic Cytopathology procedures as well as to get aware of the recent trends in Cytopathology.
CO2	BMLS-607.2	Understand about the different staining procedures
CO3	BMLS-607.3	Apply the knowledge to understand the the diagnosis of diseases, prognosis and treatment.
CO4	BMLS-607.4	Identify the various cells under microscope

SEMESTER-VII

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
   EIA
   Immunofluorescence
   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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-701.1	Study the basic virology and mycology procedures as well as to get aware of the recent trends in virology and mycology.
CO2	BMLS-701.2	Understand about the different staining procedures
CO3	BMLS-701.3	Apply the knowledge to understand the the diagnosis of diseases, prognosis and treatment.
CO4	BMLS-701.4	Identify the various cells under microscope

Suggested Readings

1. Practical Medical Microbiology by Mackie &Mac Cartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
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 Chees brough
6. Medical Mycology by Dr. Jagdish Chander

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 to 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
   Collection of blood for cross matching from a blood bag
   Major cross matching
   Minor cross matching
   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:
    Packed red cells, washed red cells and FROZEN Red cells
    Platelet Rich Plasma (PRP), Platelet concentrate and frozen platelets.
    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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-702.1	Study the introduction and development of ABO antigens and antibodies and genetic concepts
CO2	BMLS-702.2	Understand about the different types of anticoagulants used in Blood banking and various types of methods and Procedures used in Crossmatching. And study related to mendels law and chromosomes
CO3	BMLS-702.3	Apply the knowledge to understand the Various types of Blood group systems like ABO Blood group systems and RH blood group systems.
CO4	BMLS-702.4	Analyze the Principle, Procedures and important applications used in Direct and indirect coombs tests.

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 Noteson Genetics by PC Winter, GI Hickey and HL Fletcher

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
    Polymerase Chain Reaction and its advanced versions

Gel electrophoresis
Western blotting

14. Chemical composition of DNA
    DNA replication
    DNA damage and repair
    Regulation of prokaryotic and eukaryotic gene expression
    Cell Cycle

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-703.1	Study the concept related to immunopathology and molecular biology
CO2	BMLS-703.2	Understand about the different types immune response, basic concepts of Humoral and cellular immune response.
CO3	BMLS-703.3	Apply the knowledge to understand the different cells, and hypersensitivity reaction.
CO4	BMLS-703.4	Application of various molecular techniques such as polymerase chain reaction.

Suggested Readings

1. Immunology by Ivan Roitt, JonathaanBrostoff 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-704: Research Methodology and Biostatistics

Rationale: The objective of this module is to help the students understand the basic principles ofresearch 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)

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-704.1	Study the concept related to research methodology and biostatistics
CO2	BMLS-704.2	Understand about the different research designs, tools and statistical concepts
CO3	BMLS-704.3	Apply the knowledge of statistics in research
CO4	BMLS-704.4	Application of various tools and statistics in research

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-705: 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.
   Skin
   Nail
   Hair
   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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-705.1	Study the basic virology and mycology procedures as well as to get aware of the recent trends in virology and mycology.
CO2	BMLS-705.2	Understand about the different staining procedures
CO3	BMLS-705.3	Apply the knowledge to understand the the diagnosis of diseases, prognosis and treatment.
CO4	BMLS-705.4	Identify the various cells from body tissues and fluids under microscope

BMLS-706: 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
   Direct or preliminary grouping
   Indirect or proof grouping
   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
   Major cross matching

Minor cross matching
8. Preparation of various fractions of blood.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-706.1	Study the different methods involved in blood banking and genetics
CO2	BMLS-706.2	Understand about the different blood collection methods, ABO Blood group systems and RH blood group systems.
CO3	BMLS-706.3	Apply the knowledge to understand the Various types of Blood group systems like ABO Blood group systems and RH blood group systems.
CO4	BMLS-706.4	Analyze the Principle, Procedures and important applications used in Direct and indirect coombs tests.

BMLS-707: Immunopathology & Molecular Biology – Practicals

1. Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
2. T and B cell separation
3. Immunofluorescence
   Anti- Nuclear Antibody (ANA)
   Anti- Neutrophil Cytoplasmic Antibody (ANCA)
4. AIDS Immunology and Pathogenesis (AIP)
5. Thyroid Microsomal antigen (TMA)- Agglutination reactions
6. Electrophoresis
7. Gel diffusion
8. Nephlometery
9. HLA
   Typing Serology & Cross match
   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

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-707.1	Study the concept related to immunopathology and molecular biology
CO2	BMLS-707.2	Understand about the different test procedures such as ELISA, PCR, electrophoresis, blotting, isolation of RNA, DNA
CO3	BMLS-707.3	Apply the knowledge toto analyze different samples.
CO4	BMLS-707.4	Application of various molecular techniques and identification of results

BMLS-708 Research Methodology and Biostatistics – Practical

1. To practice problems on various biostatistics tools.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-708.1	Study the concept related to research methodology and biostatistics
CO2	BMLS-708.2	Understand about the different research designs, tools and statistical concepts
CO3	BMLS-708.3	Apply the knowledge of statistics in research
CO4	BMLS-708.4	Application of various tools and statistics in research

SEMESTER-VIII

BMLS-801 Internship:

The internship will span 6 months/ 1 semester. This will include 6 hours of practice a day,totaling to 720 hours during internship semester. As a part of this, the students will maintain a work logbookwhich will be duly endorsed by the supervisor or trainer. At the end of internshipthe candidate shall submit the work log book along with certificate from the training 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 demonstratecompetence in beginning and intermediate procedures. Students will observe the advanced andspecialized 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 6hours 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:
   Demonstrate ability to understand investigation/test requisition.
   Collecting the relevant clinical samples alongwith complete and accurate documentation with proper safety measures in relation to sample accountability.
   To transport the samples with precautionary measures to the relevant lab section.
   Demonstrate the ability to prepare clinical sample for processing.

   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.
   Perform mathematical calculations related to all areas of the clinical laboratory
   Ability to record the test results/data.
   To demonstrate the ability to interpret the test reports and its documentation in lab records.
   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 patients.

COURSE OUTCOMES: On completion of this course, the students will be able to

CO1	BMLS-801.1	Study about the various biological laboratory tests principles and procedures
CO2	BMLS-801.2	How to report the diagnosis test and how to relate these reports with diseases process
CO3	BMLS-801.3	Do further education to upgrade their knowledge and to be in professional competence
CO4	BMLS-801.4	Learn about the laboratory safety, infections borne from body fluids, hazardous chemical, universal precaution to protect society and lab workers along with patients from infection and how to dispose biomedical waste

GENERAL GUIDELINES

(i) The students are expected to prepare practical record book as per given list of the Experiments. Besides, they can also add other experiments as well.

(ii) (ii) External examiner along with internal faculty should evaluate the student's Performance through viva voice/spotting/performance and synopsis.

Program Name: Bachelors in Medical lab Technology
Program Code: MLT 301