ORDINANCE : H-008

Bachelor in Medical Laboratory Science (BMLS)

Notified on 12/09/2023

Established under Uttar Pradesh Private Universities

(Amendment) Act, 2023

(UP ACT No. 10 of 2023)

PREFACE

To ensure seamless education and to achieve academic excellence in the University rules and regulations for “BACHELORS IN MEDICAL LABORATORY SCIENCE (BMLS)” course is published vide Ordinance 08. These regulations will be in addition to the norms set by the regulatory body from time to time.

Faculty of Paramedical Sciences
Ordinance for Bachelors in Medical Laboratory Science (BMLS)
Duration: (4 Years)

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BACHELORS IN MEDICAL LABORATORY SCIENCE (BMLS)

1.1 Objectives/Aim of the course:

a. Proficiently perform full range of clinical laboratory tests.
b. Develop and evaluate test systems and interpretive algorithms.
c. Manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information.
d. Collection and receiving of specimens (infectious samples i.e. blood, urine, stool, sputum, pus, semen, tissues and body fluids) for various biochemical, pathological, microbiological, hematological and blood bank investigations, etc.
e. Maintenance of supplies of laboratory reagents / diagnostic kits.
f. Maintenance of quality control for reliability of laboratory reports.
g. To become knowledgeable about, comprehend, and evaluate how computer software systems are used in laboratory services

1.2 Programme Specific Outcomes:

At the end of the course, the student should be able to:

a. Perform routine clinical laboratory testing.
b. Communicate with other members of healthcare team, customers and patients in an effective manner.
c. Make specimen-oriented decisions on predetermined criteria including working knowledge of critical values.
d. Process information and ensure quality control as appropriate to routine laboratory procedures.
e. Train students in routine laboratory procedures.
f. Upgrade knowledge and skills in a changing healthcare scenario.
g. Should know the logical interpretation of clinical lab investigations.
h. Should be able to extrapolate the acquired data
i. Should be able to work on an automated machine

2. **Scope:**
   This ordinance shall apply to the program leading to Bachelors in Medical Laboratory Science (BMLS).

3. **Admission Criteria:**
   A candidate seeking admission in Bachelors in Medical Laboratory Science (BMLS) course should have completed 17 years of age, as on 31st December of the year of admission.

4. **Qualifying Examination:**

4.1 A candidate seeking admission to the Bachelors in Medical Laboratory Science (BMLS) program should have passed 10+2 examination or its equivalent conducted by Boards/Councils established by State Government/Central Government with Physics, Chemistry, Biology and English as subjects. The candidate must possess minimum 40 % marks in the qualifying examination. 5 % relaxation will be given to reserve category candidates.

4.2 Admission to BMLS course will be made as per the rules prescribed by the competent authority of the university, from time to time, in following manner:

4.2.1 Direct admission based on merit of the eligible candidates

4.2.2 Based on merit in entrance test conducted by competent authority.

5. **Lateral entry:**

5.1 Candidate(s) having two years' diploma in Medical Laboratory Techniques and registered with state medical faculty shall be eligible for admission directly in Second Year (3rd Semester) of Bachelors in Medical Laboratory Science (BMLS) course.
The marks of the diploma holder will be exempted and will not be added in the 1st year (1st & 2nd semester) of (BMLS) course. The marks of these candidates will be granted only from 2nd year onwards. For these candidates their earlier grades will be trancripted.

5.2 Admission through lateral entry to BMLS course will depend upon availability of seats.

6. **Duration of the Course:**
   The duration of the course of Bachelors in Medical Laboratory Science (BMLS) shall be 4 years (3 years and 6 months academic and 6 months of Compulsory rotatory internship).
   The maximum period for completion of program successfully should not exceed Eight Years (Nx2).

7. **Medium of Instruction:** English

8. **Attendance:**
   A candidate is required to obtain minimum 75% attendance in theory, tutorials and seminars and 80% in practical of each subject individually to be eligible to appear in the university examination. However, a relaxation may be allowed on extreme compassionate grounds by competent authority.

9. Organization of the Program:

9.1 Each academic year shall consist of two semesters each of 6 months duration.

9.2 Six months (180 days) of internship will be mandatory for award of Bachelors in Medical Laboratory Science (BMLS) Degree.

10. **Curriculum*:***

10.1 The 4-year curriculum has been divided into 8 semesters and shall include lectures, tutorials, practical, seminars, projects and case studies as defined in the scheme of instructions and examinations and executive instructions issued by the University from time to time.

10.2 The curriculum will also include other co-curricular and extracurricular activities as prescribed by the University from time to time.

11. Credit System:

Each BMLS program will have a curriculum in which every Subject (Course) will be assigned certain credits reflecting its weight and contact periods, as given below:

1 Credit Theory (L) = 1 hour per week per semester.
1 Credit Tutorial (T)= 1 hour per week per semester.
1 Credit Practical/ Lab (P)= 2 hours per week per semester.
1 Credit Clinical Posting(CP) = 3 hours of Clinical Posting hours per week per semester.

In addition to theory and laboratory courses, there may be other courses such as seminar, clinical training, projects etc., which will be assigned credits as per their contributions in the programme without regards to contact periods.

11.1 Minimum Credit Requirements:

The minimum credit required for award of a **BMLS degree is 180.**

12. Curriculum Outline:

First Semester (0-6 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-101	Basic computer & information science	3	1	-	30	70	100	4
BMLS-102	English Communication and soft skills	3	1	-	30	70	100	4
BMLS-103	Introduction to Quality & Patient Safety	4	1	-	30	70	100	5
BMLS-104	Medical Law & Ethics	4	1	-	30	70	100	5
BMLS-105	Basic Preventive Medicine and Community Health Care	4	1	-	30	70	100	5
BMLS-106	Environment Science	4	1	-	30	70	100	5
Total		**22**	**6**	**-**	**180**	**420**	**600**	**28**
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Second Semester (7-12 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -201	General Clinical Microbiology	3	1	-	30	70	100	4
BMLS -202	Basic Haematology & Clinical Pathology	3	1	-	30	70	100	4
BMLS -203	Basic Clinical Biochemistry	3	1	-	30	70	100	4
BMLS -204	Human Anatomy and Physiology	3	1	-	30	70	100	4
BMLS -205	General Clinical Microbiology – (P)	-	-	4	30	70	100	2
BMLS -206	Basic Haematology & Clinical Pathology – (P)	-	-	4	30	70	100	2
BMLS -207	Basic Clinical Biochemistry – (P)	-	-	4	30	70	100	2
BMLS -208	Human Anatomy and Physiology – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Third Semester (13-18 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -301	Systematic Bacteriology	3	1	-	30	70	100	4
BMLS -302	Basics of Hematological diseases	3	1	-	30	70	100	4
BMLS -303	Biochemical metabolism	3	1	-	30	70	100	4
BMLS -304	Fundamentals of Histology	3	1	-	30	70	100	4
BMLS -305	Systematic Bacteriology– (P)	-	-	4	30	70	100	2
BMLS -306	Basics of Hematological diseases – (P)	-	-	4	30	70	100	2
BMLS -307	Biochemical metabolism – (P)	-	-	4	30	70	100	2
BMLS -308	Fundamentals of Histology – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Fourth Semester (19-24 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-401	Applied Bacteriology	3	1	-	30	70	100	4
BMLS-402	Applied Hematology – I	3	1	-	30	70	100	4
BMLS-403	Analytical Clinical Biochemistry	3	1	-	30	70	100	4
BMLS-404	Applied Histopathology – I	3	1	-	30	70	100	4
BMLS-405	Applied Bacteriology– (P)	-	-	4	30	70	100	2
BMLS-406	Applied Hematology - I – (P)	-	-	4	30	70	100	2
BMLS-407	Analytical Clinical Biochemistry – (P)	-	-	4	30	70	100	2
BMLS-408	Applied Histopathology - I – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	26
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Fifth Semester (25-30 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -501	Immunology & Bacterial serology	3	1	-	30	70	100	4
BMLS -502	Applied Hematology – II	3	1	-	30	70	100	4
BMLS -503	Applied Clinical Biochemistry – I	3	1	-	30	70	100	4
BMLS -504	Applied Histopathology - II	3	1	-	30	70	100	4
BMLS -505	Immunology & Bacterial serology – (P)	-	-	4	30	70	100	2
BMLS -506	Applied Hematology - II – (P)	-	-	4	30	70	100	2
BMLS -507	Applied Clinical Biochemistry – I- (P)	-	-	4	30	70	100	2
BMLS-508	Applied Histopathology-II – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Sixth Semester (31-36 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-601	Medical Parasitology & Entomology	3	1	-	30	70	100	4
BMLS-602	Advanced Hematology	3	1	-	30	70	100	4
BMLS-603	Applied Clinical Biochemistry – II	3	1	-	30	70	100	4
BMLS-604	Cytopathology	3	1	-	30	70	100	4
BMLS-605	Medical Parasitology & Entomology - (P)	-	-	4	30	70	100	2
BMLS-606	Advanced Hematology - (P)	-	-	4	30	70	100	2
BMLS-607	Applied Clinical Biochemistry – II- (P)	-	-	4	30	70	100	2
BMLS-608	Cytopathology - (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Seventh Semester (37-42 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-701	Medical Virology & Mycology	3	1	-	30	70	100	4
BMLS-702	Blood Banking & Genetics	3	1	-	30	70	100	4
BMLS-703	Immunopathology & Molecular Biology	3	1	-	30	70	100	4
BMLS-704	Research methodology and Biostatistics	3	1	-	30	70	100	4
BMLS-705	Principles of Laboratory Management	3	1	-	30	70	100	4
BMLS-706	Medical Mycology and Virology - (P)	-	-	4	30	70	100	2
BMLS-707	Blood Banking & Genetics- (P)	-	-	4	30	70	100	2
BMLS-708	Immunopathology & Molecular Biology – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**15**	**7**	**12**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

NOTE:

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

Considering four months per semester as working months, total contact hours per semester shall be 550 (Five hundred and Fifty)

Eighth Semester (42-48 months)

(Six months Internship)

Internship:

There shall be six months (180 days) of compulsory rotatory internship after successful completion of seventh semester, as under:

S.No.	Lab	Days
1	Hematology & Clinical Pathology	30 Days
2	Biochemistry	30 Days
3	Microbiology & Serology	45 Days
4	Histopathology	30 Days
5	Blood Banking	30 Days
6	Cytology	15 Days

Other Details

a. The rotatory internship must be completed from the university hospital only. However, in exceptional cases on extreme compassionate grounds permission to complete the internship from other hospital may be granted by the competent authority.

b. The University shall issue a provisional degree of Bachelors in Medical Laboratory Science (BMLS) on passing the final examination and after the completion of internship on demand by the candidate.

c. Assessment of Internship:

On successful completion of internship, the Dean/Principal shall issue a certificate following which the university shall award the degree of Bachelors in Medical Laboratory Science (BMLS).

13. Course/Subject codes:

BMLS Program: In the syllabus manual of **BMLS**, each subject is assigned a specific code. The subject code consists of six to seven digits. First four digits (letters) indicate the program of BMLS, next digit (letter) indicates course which is either core/compulsory /elective/ laboratory /seminar/Project or Clinical training.

A fifth digit (number) indicates semester of a program and six and seven digit (number) indicates serial number of course. An eighth digit (number) is only applicable for elective course which indicates the serial number of elective course in that group.

For example –

Core/compulsory course, Elective course, Laboratory course, Seminar, Project

******C101, ****E101, ****F101, ****L101, ****S301, ****P401**

Where,

First four digits (letters) ***: indicates program name Fourth digit (letter)

C: indicates Core/Compulsory course

F: Indicate Foundation

E: indicates Elective course

L: indicates laboratory course;

S: indicates Seminar

P: indicates Project

Fifth digit (number) 1/2/3/4: indicates year in which that course to be studied

Sixth and Seventh digit (number) 01: indicates serial number of course.

Eighth digit (number) 1/2/3/4: indicates serial number of elective course in a group.

The first four letters used in coding of courses indicates respective programmes.

14. Examination / assessment and grading:

14.1 Components of Evaluation:

Each subject will be evaluated out of 100 marks as under:

14.1.1 Theory Subjects:

Internal Assessment (IA)	30 marks
End-Semester Examination (ESE)	70 marks

14.1.2 Practical Subjects including Seminar, Lab Posting, Project, etc.

Internal Assessment (IA)	30 marks
End-Semester Examination (ESE)	70 marks

14.2 Grading of Performance:

The letter grades and their equivalent grade point applicable for undergraduate programmes are given below:

Percentage of Marks Obtained	Letter	Grade Points	Performance
85.0 and above	O	10	Outstanding
80.0 – 84.9	A	9	Excellent
75.0 – 79.9	B	8	Very Good
65.0 – 74.9	C	7	Good
60.0 – 64.9	D	6	Fair
55.0 – 59.9	E	5	Average
50.0 – 54.9	P	4	Pass
Less than 50.0	F	0	Fail

14.2.1 : Computation of semester grade point average (SGPA) and cumulative grade point average (CGPA)

SPGA is the weighted average of the grade points obtained in all courses by the student during the semester (All courses excluding English and electives)

EX. SGPA COMPUTATION

Course Number	Credit/s	Letter grade	Grade point	Credit point (Credit × grade)
1	3 (C1)	A	8 (G1)	3 × 8 = 24
2	4 (C2)	B+	7 (G2)	4 × 7 = 28
3	3 (C3)	B	6 (G3)	3 × 6 = 18

$$\text{SGPA} = \frac{C1G1 + C2G2 + C3G3}{C1 + C2 + C3}$$

$$= \frac{70}{10} = 7 \text{ (rounded off to two decimal points)}$$

14.2.2 : Computation of CGPA

CGPA is calculated with SGPA for all semesters to two decimal points and is indicated in final grade in marks card/transcript showing grades of all 8 semesters and their courses/subjects.

CGPA reflects the failed status in case of fail until the course/s are passed.

Semester I	Semester 2	Semester 3	Semester 4
Credit –			
Cr: 20	Cr: 22	Cr: 25	Cr: 26
SGPA: 6.5	SGPA: 7.0	SGPA: 5.5	SGPA: 6.0

Cr × SGPA = 20 × 6.5

$$\text{CGPA} = \frac{20 \times 6.5 + 22 \times 7 + 25 \times 5.5 + 26 \times 6}{93}$$

$$= \frac{577.5}{93} = 6.2$$

15. Schedule of Examination:

On completion of each semester, a university examination will be conducted. Theory examinations will be of 3 hours as per university schedule followed by practical examination.

15.1 Supplementary Examination: Supplementary Examination will be held along with forthcoming odd/even semester examination as applicable.

15.2 Internal Assessment (IA):

It shall be based on evaluation of periodic tests, assignments, clinical presentations, Viva, etc. Regular periodic examinations will be conducted throughout the course. There will be a minimum of two (2) internal examinations.

The break-up of IA (30 Marks) shall be as follows:

Theory Subjects:

I. Average of Two Internal Examination — 20 Marks
II. Teacher's Assessment
   a. Tutorial /Assignment /Quizzes — 05 Marks
   b. Attendance — 05 Marks

Practical Subjects:

I. One Midterm viva –voce /tests — 20 Marks
II. Teacher Assessment
   a. Lab Record — 05 Marks
   b. Attendance — 05 Marks

15.2.1 Internal assessment of the subject shall be added to compute subject percentage.

15.2.2 The students may improve their internals assessment by appearing for "Improvement Sessional Examination."

16 Qualifying Standards:

16.1 Marks obtained in internal assessment of the Theory and Practical will be merged with the Theory & Practical marks of the University examination.

16.2 In an individual subject the minimum pass marks (including internal assessment) shall be 50% in theory and 50% in practical separately. The marks obtained in the University Examination and in the internal assessment of the subject shall be added to compute subject percentage.

17 Promotional Rules:

17.1 A student shall be declared pass in a semester when he/she passes in all the theory and practical subjects.

17.2 A student failing to satisfy the passing standards of one or more subjects in the semester shall be permitted to pursue course of the next semester and clear the back paper in the subsequent odd/even semester examination.

17.3 Students shall be allowed to keep term for Semester III if she/he passes each of Semester I and Semester II or fails in not more than 50% Subjects of Semester I and Semester II taken together.

17.4 Students shall be allowed to keep term for Semester IV irrespective of grades obtained in each Subject of Semester III.

17.5 Students shall be allowed to keep term for Semester V if she/he passes in all heads of Semester I, Semester II, Semester III and Semester IV.

17.6 A student shall be eligible to undertake internship only when he/ she has cleared all the subject of all the final and pre-final years.

18 Grace Mark: A student can be awarded 'Grace Marks' not exceeding a maximum 5 marks either in theory or practical, in not more than two subjects. The grace marks shall not be added to the aggregate marks.

19 Declaration of Result:

In an individual subject the minimum pass marks (including internal assessment) shall be 50% in theory and 50% in practical separately. The marks obtained in the University Examination and in the internal assessment of the subject shall be added to compute subject percentage.

20 Award of Division:

20.1 His/her division shall be awarded on the basis of all Semester result.
If a candidate passes all examinations in first attempt without grace and secures 75% or more marks, he/she shall be placed in 'First Division with Honors.'

20.2 If a candidate passes all examinations in first attempt and secures 60% or more marks, he/she shall be placed in First Division.

21 Award of Rank:

On the basis of Final year result, the top three candidates shall be awarded rank according to their merit provided they pass all examinations in first attempt.

22 Award of Degree:

The student shall be eligible for award of BMLS degree on successful completion of prescribed course of study i.e. he/ she must have been declared pass in result and completed Six Months Rotatory internship.

23 Scrutiny and Re-evaluation:

Scrutiny and re-evaluation shall be as per university regulations.

24 Unfair means: All cases regarding reported use of Unfair Means will be disposed as per university regulations.

25 Cancellation of admission:

The admission of a student at any stage of study shall be cancelled if he/she is not found qualified as per norms and guidelines or the eligibility criteria prescribed by the University.

ANNEXURE - 1

Syllabus

Bachelors in Science Medical Laboratory Science (BMLS)

First Semester (0-6 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-101	Basic computer & information science	3	1	-	30	70	100	4
BMLS-102	English Communication and soft skills	3	1	-	30	70	100	4
BMLS-103	Introduction to Quality & Patient Safety	4	1	-	30	70	100	5
BMLS-104	Medical Law & Ethics	4	1	-	30	70	100	5
BMLS-105	Basic Preventive Medicine and Community Health Care	4	1	-	30	70	100	5
BMLS-106	Environment Science	4	1	-	30	70	100	5
Total		**22**	**6**	**-**	**180**	**420**	**600**	**28**
Total Hours in Semester		**550**						

Subject Name: Basic computers and information science
Subject Code: BMLS-101

Unit- 1 **(10 Hrs.)**

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

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

Unit- 2 **(10 Hrs.)**

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

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

Unit- 3 **(10 Hrs.)**

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.).

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.

Unit- 4 **(10 Hrs.)**

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

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

Unit- 5 **(10 Hrs.)**

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

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

Unit- 6 **(10 Hrs.)**

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

RECOMMENDED BOOKS:

1. A first Course in Computers: Saxena, Vikas Publishing House
2. Fundamentals of Computer science - M. Afshar Alam
3. Fundamental of Information Technology by 'D. S. Yadav- New Age International

Subject Name: English Communication & Soft Skills
Subject Code: BMLS-102

Learning Objectives: To comprehend and communicate in simple English.

Unit-1: (10 Hrs.)

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.

Unit-2: (10 Hrs.)

1. Basic compositions, journals, with a focus on paragraph form and organization.
2. Basic concepts & principles of good communication.
3. Special characteristics of health communication.

Unit-3: (10 Hrs.)

1. Types & process of communication – verbal, non-verbal and written communication.
2. Upward, downward and lateral communication.
3. Therapeutic communication: empathy versus sympathy.

Unit-4: (10 Hrs.)

1. Communication methods for teaching and learning.
2. Communication methods for patient education.
3. Barriers of communication & how to overcome.

Learning Outcomes: Students will realize the significance of English for their career progression.

Students will be able to understand distinct sounds and improve pronunciation. Students will improve their English vocabulary of daily usage. Students will be able to form simple sentences to talk about themselves, friends and relatives. Students will be able to imbibe the pre-requisites of personality development.

Suggested Reading:

1. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication
2. Konar, Nira. Communication Skills for Professionals, PHI Learning Pvt. Ltd – 2011
3. Board of Editors. Written and Spoken Communication in English, University Press2007
4. Lata, Pushp & Kumar, Sanjay. Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews, PHI Learning Pvt. Ltd -2011
5. 5. Duck, Steve & McMahan, David T. The Basics of Communication: A Relational Perspective, Sage Publication-2012

Subject Name: Introduction to Quality & Patient Safety
Subject Code: BMLS-103

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

Unit-1: (10 Hrs.)

1. Quality assurance and management
2. Concepts of Quality of Care
3. Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools,
4. Introduction to NABH guidelines.

Unit-2: (10 Hrs.)

1. 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).
2. Initial recognition and response to heart attack and stroke are also considered part of BLS.
3. Vital signs and primary assessment, Basic emergency care – first aid and triage, Ventilations including use of bag-valve-masks (BVMs)
4. Choking, rescue breathing methods, One- and Two-rescuer CPR, using an AED (Automated external defibrillator), Managing an emergency including moving a patient.

Unit-3: (10 Hrs.)

1. Definition of Biomedical Waste, Waste minimization, BMW – Segregation, collection, transportation, treatment and disposal (including color coding), Liquid BMW,
2. Radioactive waste, Metals / Chemicals / Drug waste, BMW Management & methods of disinfection
3. Modern Technology for handling BMW
4. Use of Personal protective equipment (PPE), Monitoring & controlling of cross infection (Protective devices).

Unit-4: (10 Hrs.)

1. Infection prevention and control
2. Evidence-based infection control principles and practices
3. Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)
4. Prevention & control of common healthcare associated infections, Components of an effective infection control program, and Guidelines (NABH and JCI) for Hospital Infection Control.

Unit-5: **(10 Hrs.)**

1. History of antibiotics, how resistance happens and spreads,
2. Types of resistance- intrinsic, acquired, passive, Trends in drug resistance, Actions to fight resistance, Bacterial persistence
3. Antibiotic sensitivity, Consequences of antibiotic resistance
4. Antimicrobial Stewardship – Barriers and opportunities, tools and models in hospitals.

Unit-6: **(10 Hrs.)**

1. Disaster preparedness and management
2. Fundamentals of emergency management, Psychological impact management, Resource management, Preparedness and risk reduction
3. Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction)
4. Information management, incident command.

Suggested readings:

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

Subject Name: Medical Law & Ethics
Subject Code: BMLS-104

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

Unit-1: (10 Hrs.)

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

Unit-2: (10 Hrs.)

1. Autonomy and informed consent - Right of patients
2. Care of the terminally ill- Euthanasia
3. Organ transplantation
4. Medico legal aspects of medical records

Unit-3: (10 Hrs.)

1. Medico legal case and type- Records and document related to MLC
2. Ownership of medical records - Confidentiality Privilege communication
3. Release of medical information - Unauthorized disclosure - retention of medical records other various aspects.
4. Professional Indemnity insurance policy

Unit-4: (10 Hrs.)

1. Development of standardized protocol to avoid near miss or sentinel events
2. Obtaining an informed consent.
3. Ethics in the profession of Medical Laboratory Science

LEARNING OUTCOME: Student will abide by the rule and regulation of the medicine and have abundant knowledge on professional attitude and communication among the colleague, patients and co-parties.

Suggested readings:

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

Subject Name: Community Health Care
Subject Code: BMLS-105

Learning Objectives: The students will learn about the knowledge of various types of diseases and functioning of various programmes. 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.

Unit-1: Introduction: (10 Hrs.)

1. Definition and concepts of health, important public health acts
2. Health problems of developed and developing countries, environment and health.
3. Definition and concepts of epidemiology, diseases, types and use of epidemiology.
4. Basic emergency care and first aid.

Unit-2: Communicable Diseases: (10 Hrs.)

1. Epidemiology, etiology, pathogenesis and control of communicable disease like malaria, cholera,
2. Tuberculosis, leprosy,
3. Diarrhoea, poliomyelitis,
4. Viral hepatitis, measles, dengue, rabies, AIDS.

Unit-3: National Health Policy & Programs: (10 Hrs.)

1. National Health Policy and Programs: DOTS, National AIDS control programme
2. National cancer control programme, Universal immunization programme etc.
3. Nutrition and major nutritional problems, etiology, manifestations and prevention, components of RCH care.
4. Examination of water, food adulteration, role of regular exercise and yoga in prevention and management of various diseases.

Unit-4: National Population Problem: (10 Hrs.)

1. Population, problems of population growth, birth rates
2. Death rates, fertility rates, MMR., CPR
3. Approaches and methods of contraception, Reproductive and child health.
4. Hygiene and sanitation, sanitation barriers, excreta disposal.

Unit-5: Immunization & Health Planning: (10 Hrs.)

1. Immunization programme, various national immunization programs and vaccine schedules
2. Family welfare and planning, communicable and non-communicable disease
3. Health planning in India including various committees, national health policy and health goals.
4. Objectives and goals of WHO, UNICEF, Indian Red Cross Society, UNFPA, FAO, ILO

Suggested Readings:

1. K. Parks & Sunder Lal, (2015), Textbook of Preventive Social Medicine ,3rd edition, Bhanot Publications

Subject Name: Environmental Science

Subject Code: BMLS- 106

Learning Objectives: The student will be made aware of our environment in general, natural resources, ecosystems, environmental pollution and social issues related to environment.

Unit-1: Natural resources: Renewable and non-renewable resources:(10 Hrs.)

1. Water Resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.
2. Mineral Resources: Use and exploitation, environmental effects of extracting and using minerals resources, case studies.
3. Food Resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer -pesticide problems, Water logging, Salinity, case studies.
4. Energy Resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.
5. Land Resources: Land as a resource, Land degradation, Man induced landslides, Soil erosion and desertification. - Role of an individual in conservation of natural resources - Equitable use of resources for sustainable life styles.

Unit-2: Ecosystem: (10 Hrs.)

1. Concept of an Ecosystem, Structure and Function of an Ecosystem
2. Producer Consumer and decomposers
3. Energy flow in the Ecosystem
4. Ecological Succession.

Unit-3: Environmental Pollution: (10 Hrs.)

1. Definition, Causes, effects and control measures of-Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards
2. Solid Waste Management: Causes, effects and control measures of urban and Industrial Wastes.
3. Role of an Individual in prevention of pollution.
4. Pollution case studies & Disaster Management: floods, earthquake, cyclones and landslides.

Unit-4: Social Issues & Environment: (10 Hrs.)

1. Resettlement and Rehabilitation of people; its problems and concerns, case studies.
2. Environmental ethics: issues and possible solutions
3. Greenhouse effect and global Warming, effects of acid Rain and their remedial measures and ozone Layer depletion.

Unit-5: Human Population & Environment: (10 Hrs.)

1. Population growth variation among nations, Population Explosion, Family welfare programme
2. Environment and Human Health
3. Human Rights.
4. HIV/AIDS, Women and Child welfare
5. Role of Information Technology in Environment and Human Health, Case studies.

Learning Outcome: Students will understand / evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn help in sustainable development.

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.

Second Semester (7-12 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -201	General Clinical Microbiology	3	1	-	30	70	100	4
BMLS -202	Basic Haematology & Clinical Pathology	3	1	-	30	70	100	4
BMLS -203	Basic Clinical Biochemistry	3	1	-	30	70	100	4
BMLS -204	Human Anatomy and Physiology	3	1	-	30	70	100	4
BMLS -205	General Clinical Microbiology – (P)	-	-	4	30	70	100	2
BMLS -206	Basic Haematology & Clinical Pathology – (P)	-	-	4	30	70	100	2
BMLS -207	Basic Clinical Biochemistry – (P)	-	-	4	30	70	100	2
BMLS -208	Human Anatomy and Physiology – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

Subject Name: General Clinical Microbiology
Subject Code: BMLS-201

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

Unit-1: Introduction to Medical Microbiology: (12 Hrs.)

1. Definition, History, Host - Microbe relationship
2. Glassware Used in Microbiology- Introduction, Care and handling of glassware, Cleaning of glassware.
3. 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

Unit-2: Sterilization:

1. Definition, Types and principles of sterilization methods
2. Heat (dry heat, moist heat with special Reference to autoclave)
3. Radiation, Filtration
4. Efficiency testing to various sterilizers

Unit-3: Antiseptics and Disinfectants: (12 Hrs.)

1. Definition, Types and properties.
2. Mode of action - Uses of various disinfectants
3. Precautions while using the disinfectants - Qualities of a good disinfectant
4. Testing efficiency of various disinfectants
5. Types of the waste generated – Segregation – Treatment – Disposal

Unit-4: General characteristics & classification of Microbes & Nutrition: (12 Hrs.)

1. Classification of microbes with special reference to prokaryotes & eukaryotes
2. Morphological classification of bacteria, Bacterial anatomy (Bacterial cell structures).
3. General nutritional & other requirements of the bacteria
4. Classification of bacteria on the basis of their nutritional requirements
5. Physical conditions required for growth, Normal growth cycle of bacteria (growth curve).

Unit-5: Types of microbial cultures & Immunology: (14 Hrs.)

1. Culture media: Introduction
2. Classification of culture media (Example & Uses) solid media, liquid media, semisolid,Media, routine/synthetic/defined media, basal media, enriched, enrichment, Selective differential media, sugar fermentation media, transport media, preservation media and anaerobic culture media
3. Quality control in culture media, Automation in culture media preparation

4. Aerobic & anaerobic culture methods: Concepts, Methods Used for aerobic cultures, Methods used for anaerobic cultures
5. Introductions to Immunology: Immunity, Antigens and Antibodies
6. Care & handling of laboratory animals: Introduction, General care & handling.
7. Ethics & legality in use of laboratory animals.

Learning Outcomes: This course makes the students to know handling of instruments and sterilization techniques, able to make Various Culture media to improve quality ofInvestigation by Followed Quality Control. Students also having knowledge about Immunology.

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
6. Text book of Microbiology by Prescott
7. Microbiology for Medical Sciences by Bhagat Singh and Renu Singh

Subject Name: Basic Haematology & Clinical Pathology
Subject Code: BMLS-202

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

Unit-1: Introduction to Haematology: (12 Hrs.)

1. 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

Unit-2: (12 Hrs.)

1. Collection and preservation of blood sample for various hematological investigations
2. Formation of cellular components of blood (Haemopoiesis), Erythropoiesis, Leucopoiesis, Thrombopoiesis.
3. Hemoglobin: definition, types, structure, synthesis and degradation
4. Morphology of normal blood cells

Unit-3: (12 Hrs.)

1. Normal Hemostasis & physiological properties of coagulation factors.
2. Quality assurance in Haematology
3. Internal and external quality control including reference preparation
4. Routine quality assurance protocol
5. Statistical analysis i.e. Standard deviation, Co-efficient of variation, accuracy and precision

Unit-4: (12 Hrs.)

1. Preparation of thin and thick smears and its uses; staining of blood smears; Differential leucocytes count by manual and automated method; Physiological and pathological variations in leukocyte values;
2. Theory of erythrocyte sedimentation rate; Measurement of ESR - manual and automated method;
3. Hematocrit and red cell indices - Its use in clinical practice; Principle of automated blood cell counter;
4. Reticulocyte count - Stains used; normal values; use of reticulocyte count in clinical practice;

Unit-5: (12 Hrs.)

1. Collection, transport and preservation of clinical specimens other than blood; Processing of various clinical Specimens; CSF examination in clinical practice
2. Semen analysis in clinical practice; Sputum examination as relevant to Pathology lab; Stool examination as relevant to Pathology lab
3. Mechanism of coagulation, coagulation factors; Common disorders of bleeding and coagulation;

4. Approach to a patient with bleeding disorder; Bleeding time, clotting time, Platelet count
5. Prothrombin time, Prothrombin concentration, INR; Clot retraction test and APTT

Learning Outcomes: Students will be able to collect, preserve and process blood samples. They will be able to perform efficiently routine investigations in clinical hematology laboratory. Students will also be able to carry out different immune-hematological investigations and coagulation profile tests. They will be able to handle automated instruments.

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

Subject Name: Basic Clinical Biochemistry
Subject Code: BMLS-203

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

Unit-1: (12 Hrs.)

1. Introduction to Medical lab. Technology, Role of Medical Lab Technologist
2. Ethics and responsibility, Safety measures, First aid
3. Cleaning and care of general laboratory glass ware and equipment: Steps involved in cleaning soda lime glass, Steps involved in cleaning borosil glass
4. Preparation of chromic acid solution, Storage

Unit-2: (12 Hrs.)

1. Method of preparation of distilled water, Type of water distillation plants, Storage of distilled water
2. Units of Measurement: S.I unit and CGS units, Conversion
3. Strength, molecular weight, equivalent weight
4. Normality, Molarity, Molality, Numerical

Unit-3: (12 Hrs.)

1. Calibration of volumetric apparatus: Flask, Pipettes, Burettes, Cylinders
2. Analytical balance: Principle, Working, Maintenance
3. Concept of pH: Definition, Henderson Hassel batch equation, Pka value, pH indicator
4. Methods of measurement of pH: pH paper, pH meter, Principle, working, maintenance and calibration of pH meter

Unit-4: (12 Hrs.)

1. Volumetric analysis: Normal and molar solutions
2. Standard solutions
3. Preparation of reagents
4. Storage of chemicals

Unit-5: (12 Hrs.)

1. Osmosis: Definition, Types of osmosis, Factors affecting osmotic pressure
2. Specimen collection and Processing of Blood, Urine and CSF, Separation of Serum and Plasma for Biochemical Analysis
3. Deproteinization of sample, Handling of specimens for Testing, Transport of specimen
4. Preservation of specimen, Factors affecting the Clinical results, Effects of Storage on sample

Learning Outcomes: Students will comprehend the basics of Reagent preparation, Instrumentation and Sample analysis.

Students will able to collect various specimens for Biochemistry Investigation, they will able to Calibrate and maintain Various instruments and Glasswares.

Suggested Readings:

1. Text book of Medical Laboratory Technology by P. B. Godkar
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

Subject Name: Human Anatomy and Physiology
Subject Code: BMLS-204

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

Unit-1: Introduction to human Anatomy and Physiology (12 Hrs.)

1. Cell and cell organelles: Structure and classification, Function, Cell division (Mitosis and Meiosis)
2. Tissues: Definition, Classification with structure and Functions
3. Epithelial tissues, Connective tissues, Muscular tissues, Nervous tissue
4. Blood: Composition & Function of blood

Unit-2: Muscular skeletal system & Lymphatic System (10 Hrs.)

1. Introduction, Classification, Structure and function of skeletal system, muscles and joints.
2. Various movements of body
3. Lymphatic system: Introduction, Structure and function, Lymph nodes
4. Spleen, Thymus gland, Tonsils

Unit-3: Respiratory System & Sense Organs (10 Hrs.)

1. Introduction, Structure, Function
2. Mechanism of breathing and respiration
3. Various terms involved in respiratory System: Vital capacity, Total Volume, Reserve volume, Total lung capacity
4. Structure and function of sense organ: Eye Ear, Nose Tongue

Unit-4: Cardiovascular System & Endocrine System (10 Hrs.)

1. Anatomy and physiology of heart
2. Blood circulation: Arteries and veins
3. Conductive system of heart, Cardiac cycle, Introduction to ECG
4. Endocrine system: Endocrine & exocrine glands, their location, structure & functions

Unit-5: Body fluids and their significance (08 Hrs.)

1. Important terms, types of body fluid, total body water, a venue by which water leaves and enters body, general principles for fluid balance
2. Cardinal principle, how body fluids maintain Homeostasis, Electrolytes & ions
3. Function of electrolytes, how electrolyte imbalance leads to fluid imbalance

Unit-6: Digestive system: (08 Hrs.)

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

Unit-6: Genital system & Urinary System: (10 Hrs.)

1. Structure of male and female reproductive system,
2. Gametogenesis in male, female, menstrual cycle.
3. Placenta and extra embryonic membranes.
4. Urinary system: Main parts, Structure& function of kidney, structure of nephron,
5. Physiology of excretion & urine formation, urine.

Unit-7: Nervous system: (06 Hrs.)

1. Parts, function & structure; brain, spinal cord, spinal & cranial nerves
2. All none principle, role of neurotransmitters in transmission of nerve impulse

Learning Outcomes: This curriculum can stimulate the students to understand the basic anatomy of included system and the resultant unified organization thereupon.

Students will able to understand functioning of various systems as well as its applied aspects.

Suggested readings:

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

Subject Name: General Clinical Microbiology- (Practical)
Subject Code: BMLS-205

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. To demonstrate the different morphological types of bacteria
12. Preparation of one culture media from each type
13. To demonstrate aerobic culture
14. To demonstrate anaerobic culture
15. Visit to animal house & demonstrate about care of laboratory animals

Subject Name: Basic Haematology & Clinical Pathology- (Practical)
Subject Code: BMLS-206

1. Preparation of various anticoagulants:

   1.1 EDTA
   1.2 Sodium Citrate
   1.3 Oxalate with Fluoride
2. Collection of blood sample for various Lab Investigations
3. Familiarization and working of routine Haematology Lab.
4. Instruments

4 .1 Microscopes

   4.2 Haemocytometers
   4.3 Colorimeter
   4.4 Spectrophotometer
   4.5 Glass pipettes & Auto pipettes
   4.6 Glassware
   4.7 Sahli 's Apparatus

5. Identification of Normal blood cells
6. Urine Analysis:
   6.1 Routine biochemistry of Urine for:
   Physical Examination
   Biochemical Examination
   Microscopic Examination of Urine

Subject Name: Basic Clinical Biochemistry - (Practical)
Subject Code: BMLS-207

1. Cleaning of the laboratory glass ware (Volumetric and non-volumetric)
2. Preparation of distilled water
3. Principle, working and maintenance of pH meter.
4. To prepare 0.1 N NaOH solution.
5. To prepare 0.2N HCl solution.
6. To prepare 0.1 molar H_2SO_4
7. To prepare 0.2 Molar Sodium carbonate solution.
8. Demonstration of osmosis and dialysis.

Subject Name: Human Anatomy and Physiology - (Practical)
Subject Code: BMLS-208

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

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

Third Semester (13-18 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -301	Systematic Bacteriology	3	1	-	30	70	100	4
BMLS -302	Basics of Hematological diseases	3	1	-	30	70	100	4
BMLS -303	Biochemical metabolism	3	1	-	30	70	100	4
BMLS -304	Fundamentals of Histology	3	1	-	30	70	100	4
BMLS -305	Systematic Bacteriology– (P)	-	-	4	30	70	100	2
BMLS -306	Basics of Hematological diseases – (P)	-	-	4	30	70	100	2
BMLS -307	Biochemical metabolism – (P)	-	-	4	30	70	100	2
BMLS -308	Fundamentals of Histology – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

Subject Name: Systematic Bacteriology
Subject Code: BMLS-301

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

Unit-1: Bacterial culture & staining techniques in bacteriology: (10 Hrs.)

1. Instruments used to seed culture media, Culture procedures – seeding a plate.
2. Significance of staining in bacteriology-
3. Principle, Reagent preparation, procedures and interpretation of- Simple staining, Gram staining, Negative staining, Albert's staining, Neissre's staining, Ziehl- Neelsen staining,
4. Capsule staining, Spore Staining, Flagella staining, Fontana stain for spirochetes.

Unit-2: Biochemical tests for identification of different bacteria: (10 Hrs.)

1. Principle, procedures and interpretation of the following biochemical tests- Catalase, Coagulase, Indole, Methyl Red
2. Principle, procedures and interpretation of the following biochemical tests- Voges Proskauer, Urease, Citrate, Oxidase
3. TSIA, Nitrate reduction, Carbohydrate fermentation, Huge and Leifson, Bile solubility
4. H 2 S production, Demonstration of motility, Decarboxylases, CAMP, Hippurate hydrolysis, Nagler 's reaction, Cholera-red reaction.

Unit-3: Definition, Classification, Various, pathogenesis and laboratory diagnosis of the following bacteria-: (10 Hrs.)

1. Staphylococcus, Streptococcus
2. Pneumococcus, Neisseria gonorrhea and Neisseria meningitis
3. Haemophilis, Corynebacterium
4. Escherichia coli, Klebsiella, Citrobacter, Enterobacter

Unit-4: Definition, Classification, Various, pathogenesis and laboratory diagnosis of the following bacteria-: (10 Hrs.)

1. Proteus, Salmonella, Shigella, Yersinia enterocolitica and Yersinia pestis .
2. Vibrio, Aeromones and Plesiomonas
3. Clostridia of wound infection
4. Mycobacterium tuberculosis complex, Atypical Mycobacteria and M. leprae

Unit-5: Definition, Classification, Various, pathogenesis and laboratory diagnosis of the following bacteria-: (10 Hrs.)

1. Spirochetes – Treponema, Borrellia and leptospira
2. Bordetella and brucella , Mycoplasma and Ureaplasma , Rickettsia , Chlamydia ,
3. Actinomyces, Pseudomonas and Burkholderia
4. Brief introduction about non sporing anaerobic cocci and bacilli

Learning Outcomes: Students will know basics and procedure of different parameters used to assess Characteristics of different kinds of bacteria.

Students will perform different Biochemical & special test to identify various bacteria.

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
3. Medical Microbiology by Panikar& Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee
5. Microbiology for Medical Sciences by Bhagat Singh and Renu Singh

Subject Name: Basic of Hematological Diseases
Subject Code: BMLS-302

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

Unit-1: Anemia: (10 Hrs.)

1. Introduction, Classification, Clinical Features, Evaluation and Investigation.
2. Microcytic hypochromic anemia
3. Macrocytic anemia
4. Normocytic normochromic anemia

Unit-2: Anemia: (10 Hrs.)

1. Quantitative disorders of Leukocytes Cause and significance
2. Granulocytic and Monocytic Disorders
3. Lymphocytic Disorders
4. Morphologic Alterations in Neutrophils, Toxic granulation, Cytoplasmic vacuoles, Döhle bodies, May–Hegglin anomaly Alder–Reilly anomaly, Pelger–Huët anomaly, Chédiak–Higashi syndrome.

Unit-3: Bleeding disorders: (10 Hrs.)

1. Introduction, definition, types and Causes of bleeding.
2. Vascular defect, Platelet defect
3. Factor deficiency
4. Inhibitors, Hyper fibrinolysis

Unit-4: Types of bleeding disorders: (10 Hrs.)

1. Inherited bleeding disorders
2. Acquired bleeding disorders
3. Thrombosis: Introduction & Causes of thrombosis
4. Monitoring of Anticoagulants, Oral anticoagulants by INR, Heparin

Unit-5: Evaluation of bleeding disorders: (10 Hrs.)

1. Patient History, Clinical Features
2. BT, CT, Platelets Count
3. PT, APTT, PTT
4. D-Dimer test, Fibrinogen Assay

Learning Outcomes: This course made the students competent enough to perform various laboratory test related to acute and chronic hematological disorders and Bleeding Disorders.

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

Subject Name: Biochemical Metabolism
Subject Code: BMLS-303

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

Unit-1: Carbohydrate Metabolism: (10 Hrs.)

1. Introduction, Importance and Classification
2. Digestion and Absorption
3. Metabolism: - Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenolysis, Glycogenesis
4. Disorders of carbohydrate metabolism.

Unit-2: Protein Metabolism: (10 Hrs.)

1. Introduction, Importance and classification, Important properties of proteins
2. Digestion & absorption of Proteins
3. Protein synthesis, Metabolism of proteins
4. Disorders of protein metabolism and Urea Cycle

Unit-3: Lipids: (10 Hrs.)

1. Introduction & Classification
2. Digestion & absorption of fats
3. Lipoproteins
4. Fatty acid biosynthesis & fatty acid oxidation

Unit-4: Nucleic Acid & Vitamins: (10 Hrs.)

1. Introduction & Functions of Nucleic acid
2. Brief about structure of DNA & RNA, DNA Replication, & Transcription
3. Advances in Genetic Engineering
4. Vitamins: Definition, classification, functions dietary sources, daily requirement & Deficiency disorders.

Unit-5: Enzymes & Hormones: (10 Hrs.)

1. Introductions, Importance Classifications & Properties of enzymes
2. Mechanism of enzyme action, Factors affecting enzyme action
3. Enzyme kinetics & enzyme inhibiters
4. Hormones: Introduction Definition & Classification of hormones. Mechanism of hormone action, Effects of hormones on various metabolism & hormonal disorders

Learning Outcomes: Students will know about various metabolism and different biochemical cycles, their production, lyses, requirements and uses.

Suggested Readings:

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godkar
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

Subject Name: Fundamentals of Histopathology
Subject Code: BMLS-304

Learning Objectives: The student will study diseases associated with different body organs and systems.

Unit-1: Alimentary & Digestive System: (14 Hrs.)

1. 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.
4. Gall Bladder- Gall stones, jaundice and cardiovascular diseases.

Unit-2: Circulatory & Respiratory System: (14 Hrs.)

1. Diseases of Blood vessels- Atheroma, Arteriosclerosis, heart block.
2. Disorders of Blood Pressure-Hyper & Hypotension.
3. Respiratory System: Upper respiratory tract infection, Bronchi, Asthma
4. Pneumonia, Lung abscess, Tuberculosis, Lung Collapse.

Unit-3: Urinary & Reproductive System: (14 Hrs.)

1. Glomerulonephritis, Nephrotic syndrome, renal failure, renal calculi
2. Urinary obstruction, Urinary tract infection.
3. Reproductive system: Sexually transmitted diseases, Pelvic inflammatory disease
4. Disorder of cervix (CIN), Disease of ovaries, ectopic pregnancy, prostatitis, Infertility.

Unit-4: Nervous, Endocrine System & Sense Organs: (14 Hrs.)

1. Neuronal damage, ICP, Cerebral Infarction, head injury, Alzheimer ‘s disease, dementia.
2. Endocrine System, Pituitary: Hyper & Hypo secretions.
3. Thyroid: Goiter, Adrenal: Cushing Syndrome, Addison Disease, Pancreas: Diabetes.
4. Ear: Otitis, Eye: Cataract.

Learning Outcomes: Students will able to identify the gross sections as per the nature of organs, tissue and 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

Subject Name: Systematic Bacteriology- Practical
Subject Code: BMLS-305

1. To demonstrate the instruments used to seed culture media
2. To learn techniques for Inoculation of bacteria on culture media
3. To isolate specific bacteria from a mixture of organisms.
4. To demonstrate simple staining (Methylene blue)
5. To prepare India ink preparation to demonstrate negative staining.
6. Bacterial identification: To demonstrate reagent preparation, procedure and interpretation for
   6.1 Gram stain
   6.2 Albert stain
   6.3 Neissre's staining
   6.4 Z-N staining
   6.5 Capsule staining
   6.6 Demonstration of flagella by staining methods
   6.8 Spore staining
   6.8 To demonstrate spirochetes by Fontana staining procedure
7. To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria:
   7.1 Catalase
   7.2 Coagulase
   7.3 Indole
   7.4 Methyl Red (MR)
   7.5 Voges Proskauer (VP)
   7.6 Urease
   7.7 Citrate
   7.8 Oxidase
   7.9 TSIA
   7.10 Nitrate reduction
   7.11 Carbohydrate fermentation
   7.12 Huge and Leifson
   7.13 Bile solubility
   7.14 H2S production
   7.15 Demonstration and motility
   7.16 Decarboxylases
   7.17 CAMP
   7.19 Hippurate hydrolysis
   7.19 Nagler ‘s reaction
8. To demonstrate various characteristics (morphological, cultural and biochemical) of bacteria commonly isolated from clinical samples i.e.
   8.1 Staphylococcus
   8.2 Streptococcus
   8.3 Corynebacterium
   8.4 Escherichia coli
   8.5 Klebsiella
   8.6 Citrobacter
   8.7 Enterobacter
   8.8 Proteus
   8.9 Salmonella
   8.10 Shigella
   8.11 Vibrio cholera
   8.12 Mycobacterium tuberculosis

Subject Name: Basic of Hematological Diseases- Practical
Subject Code: BMLS-306

1. Parts of microscope; its functioning and care
2. Parts of centrifuge; its functioning and care
3. General Blood Picture
4. TLC Count
5. DLC Count
6. Platelets Count
7. Demonstration of Normal & Alternatives forms of RBC, s
8. Demonstration of Normal & Alternatives forms of WBC, s
9. PT, APTT, PTT Test
10. BT, CT & Fibrinogen Assay
11. Hemoglobin estimation methods (Sahli 's, Oxyhemoglobin, and cyanmethaemoglobin)
12. Preparation of thick and thin blood smear for malarial parasite (Leishman/Giemsa/JSB)

Subject Name: Biochemical Metabolism
Subject Code: BMLS-307

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

Subject Name: Fundamentals of Histopathology-Practical
Subject Code: BMLS-308

1. To study squamous cell from cheek cells (Buccal mucosa)
2. To study stained slide preparation from organs of digestive system
3. Study of stained slides of liver, pancreas, gall bladder
4. Study of various types of microscope and draw diagram in practical notebook
5. To study stained slide preparation from organs of circulatory system
6. To study stained slide preparation from organs of Respiratory system
7. To study stained slide preparation from organs of Nervous system
8. To study stained slide preparation from organs of Urinary system
9. To study stained slide preparation from organs of Endocrine system

Fourth Semester (19-24 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -401	Applied Bacteriology	3	1	-	30	70	100	4
BMLS -402	Applied Hematology – I	3	1	-	30	70	100	4
BMLS -403	Analytical Clinical Biochemistry	3	1	-	30	70	100	4
BMLS -404	Applied Histopathology – I	3	1	-	30	70	100	4
BMLS -405	Applied Bacteriology– (P)	-	-	4	30	70	100	2
BMLS -406	Applied Hematology - I – (P)	-	-	4	30	70	100	2
BMLS -407	Analytical Clinical Biochemistry – (P)	-	-	4	30	70	100	2
BMLS-408	Applied Histopathology - I – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	26
Total Hours in Semester		**550**						

Subject Name: Applied Bacteriology
Subject Code: BMLS-401

Learning Objectives: 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.

Unit-1: (14 Hrs.)

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. Upper Respiratory tract infections
2. Lower respiratory tract infections
3. Wound, skin, and deep sepsis
4. Urinary tract infections
5. Genital Tract infections
6. Meningitis
7. Gastro intestinal infections
8. Enteric fever
9. Tuberculosis (Pulmonary and Extra-pulmonary)
10. Pyrexia of unknown origin

Unit-2: Antibiotic susceptibility testing in bacteriology: (14 Hrs.)

1. Definition of antibiotics
2. Culture medium used for Antibiotic susceptibility testing
3. Preparation and standardization of inoculum
4. Control bacterial strains
5. Choice of antibiotics
6. MIC and MBC: Concepts and methods for determination
7. Various methods of Antibiotic susceptibility testing with special reference to Stokes and Kirby-Bauer method

Unit-3: (14 Hrs.)

1. Basics of Nucleic acid techniques in diagnostic microbiology with special reference to Polymerase chain reaction (PCR)
2. Automation in bacterial culture detection and antimicrobial susceptibility testing: Principles and importance.
3. Bacteriological examination of water, food.
4. Introduction and importance of other bacteria considered as indicators of fecal contamination

Unit-4: Examination of Milk and milk products : (14 Hrs.)

1. Basic Concepts regarding gradation of milk, Various tests for Bacteriological examination of milk
2. Basic Concepts regarding classification of food like frozen food, canned food, raw food, cooked food etc.

3. Various tests for Bacteriological examination with special reference to food poisoning bacteria
4. Examination of Air, Significance of air bacteriology in healthcare facilities, Collection processing and reporting of an air sample

Unit-5: Sterility testing of I/v fluids & Nosocomial Infection: (14 Hrs.)

1. 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.
3. Surveillance of hospital environment for microbial load, Role of microbiology laboratory in control of nosocomial infections
4. Epidemiological markers: Introduction, Types, Serotyping, Phage typing and Bacteriocin typing

Learning Outcomes: Understanding the significance of microorganisms in biogeochemical cycling of nutrients, sustainable development and bioremediation of pollutants for developing strategies of environmental conservation and remediation.

To learn various methods for their isolation, detection and identification of microorganisms in food and dairy and employ in industries.

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
3. Medical Microbiology by Panikar Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Cheesbrough
6. Hospital Acquired Infections-Power strategies for clinical practice by Dr. V Muralidhar and Sumathi Muralidhar
7. Control of Hospital infection-A Practical Handbook by GajAyliffe, A.P. Fraise, A.M. Geddes, K. Mitchell
8. Microbiology for Medical Sciences by Bhagat Singh and Renu Singh

Subject Name: Applied Haematology-I
Subject Code: BMLS-402

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

Unit-1: (14 Hrs.)

1. Haemoglobinometry: Different methods to measure Hemoglobin with merits and demerits
2. Haemocytometery: Introduction, Principle, Reagent preparation, procedure, errors involved and means to minimize errors.
3. RBC, s & WBC, s Count
4. Platelets & Absolute Eosinophils Count

Unit-2: (10 Hrs.)

1. Principle mechanism and different methods with merit and demerits for the measuring ESR.
2. Principle mechanism and different methods with merit and demerits for the measuring PCV.
3. Preparation of thin and thick smears and its uses; staining of blood smears
4. Differential leucocytes count by manual and automated method

Unit-3: (10 Hrs.)

1. Romanowsky Stain: Principle, composition, preparation of staining reagents and procedure of the following stains: Giemsa ‘s stain, Leishman ‘s stain
2. Wright ‘s stain, Field ‘s stain, JSB stain.
3. Differential leucocytes count by manual and automated method
4. Physiological and pathological variations in leukocyte values

Unit-4: (14 Hrs.)

1. **Semen analysis:** Sample Collection, Transportation Preservation, Physical Examination, Biochemical Examination & Microscopic Examination.
2. **CSF analysis:** Sample Collection, Transportation Preservation, Physical Examination, Biochemical Examination & Microscopic Examination.
3. **Pleural Fluid analysis:** Sample Collection, Transportation Preservation, Physical Examination, Biochemical Examination & Microscopic Examination.
4. **Others Fluid analysis:** Sample Collection, Transportation Preservation, Physical Examination, and Biochemical Examination & Microscopic Examination

Unit-5: (10 Hrs.)

1. Preparation of Reagents for coagulation studies: M/40 Calcium chloride, Brain Thromboplastin
2. Preparation of Reagents for coagulation studies: Cephalin, Adsorbed Plasma
3. Screening Tests for coagulation Studies and their significance

Learning Outcomes: Students will be able to collect, preserve and process blood samples. They will be able to perform efficiently routine investigations in clinical hematology laboratory. Students will also be able to carry out different immune-hematological investigations and coagulation profile tests.

Suggested Readings:

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

Subject Name: Analytical Clinical Biochemistry
Subject Code: BMLS-403

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

Unit-1: Spectrophotometry and Colorimetry.

1. Introduction, Theory of spectrophotometry and colorimetry,
2. Lambert`s law and Beer`s law
3. Applications of colorimetry and spectrophotometry.

Unit-2: Photometry: (10 Hrs.)

1. Introduction, General principles of flame photometry
2. Limitations of flame photometry, Instrumentation
3. Applications of flame photometry
4. Atomic absorption spectroscopy – Principle & applications.

Unit-3: Chromatography: (10 Hrs.)

1. Paper Chromatography & Gel Chromatography: Introduction, principle, types, details for qualitative and quantitative analysis, application.
2. Thin layer chromatography: Introduction, experimental techniques, application of TLC, limitations, High performance thin layer chromatography.
3. Column chromatography & Gas chromatography: Introduction, principle column efficiency, application of column chromatography.
4. Ion exchange chromatography: Introduction, Definition and principle, cation and anion exchangers, application.

Unit-4: Electrophoresis: (10 Hrs.)

1. Introduction, Principle, Instrumentation, Applications
2. Types of electrophoresis, Paper electrophoresis
3. Gel electrophoresis.
4.

Learning Outcomes: students will be able to:

1. Describe and compare a range of analytical chemistry methods and explain the underlying theoretical principles;

2. Explain the broad role of analysts in quality control and assessment of experimental measurements from various application contexts;

3. Employ a variety of analytical methods to prepare, separate and characterize samples from various matrices;

4.As part of a team or individually, conduct, analyze and interpret results of a chemical analysis and effectively communicate these in written reports and other formats;

5. Work safely and competently in an analytical laboratory setting.

Suggested readings:

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godkar
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

Subject Name: Applied Histopathology-I
Subject Code: BMLS-404

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

Unit-1: Introduction: (10 Hrs.)

1. Introduction to Histotechnology
2. Compound microscope: Optical system, magnification and maintenance.
3. Applications of various types of microscopes i.e. dark field, polarizing, phase contrast, interference and fluorescent microscope
4. Care and maintenance of laboratory equipment used in Histotechnology

Unit-2: Fixation & Decalcification: (10 Hrs.)

1. Safety measures in a histopathology laboratory
2. Basic concepts about routine methods of examination of tissues: Collection and transportation of specimens for histological examination
3. Basic concepts of fixation: Various types of fixatives used in a routine histopathology laboratory, Simple fixatives, Compound fixatives Special fixatives for demonstration of various tissue elements
4. Decalcification: Criteria of a good decalcification agent, Technique of decalcification followed with selection of tissue, fixation.

Unit-3: Tissue Processing: (10 Hrs.)

1. Processing of various tissues for histological examination, Steps & Methods.
2. Procedure followed by Dehydration, Clearing, Infiltration and routine timing schedule for manual or automatic tissue processing.
3. Components & principles of various types of automatic tissue: Processors
4. Embedding: Definition Various types of embedding media

Unit-4: Section Cutting: (10 Hrs.)

1. Section Cutting: Introduction regarding equipment used for sectioning
2. Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping, various types of microtome and their applications
3. Freezing Microtome and various types of Cryostats.
4. Faults in paraffin section cutting with reason and remedy, spreading the sections and attachment or mounting of sections to glass slides.

Unit-5: Staining, Impregnation and Mountants: (12 Hrs.)

1. Types of Stains, Chemical Staining Action, Mordants and Accentuators, Metachromasia
2. Preparation of Stains, solvents, aniline water and buffers etc.

3. General Staining Procedures for Paraffin Infiltrated and Embedded tissue, Nuclear Stains and Cytoplasmic stains
4. Equipment and Procedure for manual Staining and Automatic Staining Technique
5. Commonly used Mountants in Histotechnology lab, Mounting of Cover Slips, Labeling and Cataloguing the Slides

Learning Outcomes: Students will be able to identify the purpose, ingredients, function, and action of histological fixatives and the criteria for choosing the appropriate fixative.
Students will be able to demonstrate proper orientation and embedding of tissue specimens in paraffin.
Students will be able to demonstrate the ability to cut acceptable sections while performing routine microtomy of paraffin embedded tissue.

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

Subject Name: Applied Bacteriology-Practical
Subject Code: BMLS-405

1. Inoculation of different culture media
2. Isolation of pure cultures
3. Processing of following clinical samples for culture and identification of bacterial pathogens:
   1.1 Blood
   1.2 Throat swab
   1.3 Sputum
   1.4 Pus
   1.5 Urine
   1.6 Stool for Salmonella, Shigella and Vibrio cholerae
   1.7 C.S.F. and other body fluids
4. Demonstration of PCR
5. Demonstration of automation in bacterial culture detection and antimicrobial susceptibility testing
6. Antimicrobial susceptibility testing
7. Preparation and standardization of inoculums
8. To demonstrate reference bacterial strains
9. To determine MIC and MBC of known bacteria against a known antibiotic
10. To perform antibiotic susceptibility testing of clinical isolates by using
    10.1 Stokes method
    10.2 Kirby-Bauer method
11. Collection, transportation and processing of following articles for bacteriological examination:
12. Water, Milk, Food and Air
13. To demonstrate sterility testing of intravenous fluid with positive and negative controls
14. Demonstration of serotyping and bacteriocin typing
15. Demonstration of lyophilization and other available preservation methods

Subject Name: Applied Haematology-I-Practical
Subject Code: BMLS-406

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

Subject Name: Analytical Clinical Biochemistry-Practical
Subject Code: BMLS-407

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.

Subject Name: Applied Histopathology-I
Subject Code: BMLS-408

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

Fifth Semester (25-30 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS -501	Immunology & Bacterial serology	3	1	-	30	70	100	4
BMLS -502	Applied Hematology – II	3	1	-	30	70	100	4
BMLS -503	Applied Clinical Biochemistry – I	3	1	-	30	70	100	4
BMLS -504	Applied Histopathology - II	3	1	-	30	70	100	4
BMLS -505	Immunology & Bacterial serology – (P)	-	-	4	30	70	100	2
BMLS -506	Applied Hematology - II – (P)	-	-	4	30	70	100	2
BMLS -507	Applied Clinical Biochemistry – I- (P)	-	-	4	30	70	100	2
BMLS-508	Applied Histopathology-II – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

Subject Name: Immunology & Bacterial Serology
Subject Code: BMLS-501

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

Unit-1: History and introduction to immunology: (10 Hrs.)

1. Immunity
2. Innate
3. Acquired immunity
4. Basic concepts about their mechanisms

Unit-2: Antigen & Antibody: (10 Hrs.)

1. Definition, types of antigens and determinants of antigenicity
2. Definition, types, structure and properties of immunoglobulin
3. Antigen-Antibody reactions: Definition, Classification, General features and mechanisms
4. Applications of various antigen antibody reactions

Unit-3: Techniques Used in Medical Microbiology: (10 Hrs.)

1. Principle, procedure and applications of under mentioned in Medical Microbiology: Complement fixation test
2. Immuno- fluorescence, ELISA
3. SDS-PAGE
4. Western blotting

Unit-4: Serological Test & Complement System: (10 Hrs.)

1. Principle, procedure and interpretation of various serological tests:
a. Widal, VDRL, ASO
2. CRP, Brucella tube agglutination, Rose-Waaler
3. Complement system: Definition, Basic concepts about its components
4. Complement activation pathways

Unit-5: Immune Response, Hypersensitivity & Vaccines: (12 Hrs.)

1. Immune response: Introduction, Basic concepts of Humoral and Cellular immune responses
2. Hypersensitivity: Definition, Types of hypersensitivity reactions
3. Basic concepts of autoimmunity and brief knowledge about autoimmune diseases
4. Automation in diagnostic serology

5. Vaccines: Definition, Types, Vaccination schedule
6. Brief knowledge about Extended programme of immunization ‘(EPI) in India

Learning Outcomes: The ability to understand, implement and troubleshoot the concepts related to the fields of Immunology and Serology which will enable them to analyze and develop solutions to microbiology, immunology and Serology related problems using knowledge and hands-on skills in immunodiagnostics, screening for useful Serological Investigation in relevant protocols.

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayan
3. Medical Microbiology by Panikar & Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Cheesbrough
   Immunology by Riot
6. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
7. Microbiology for Medical Sciences by Bhagat Singh and Renu Singh

Subject Name: Applied Haematology-II
Subject Code: BMLS-502

Learning Objectives: The students will be made aware of the safety precautions in Haematology, basic concepts of Automation, quantitative assay of coagulation factors, Karyo typing etc. and will learn about concepts such as safety precautions, quality assurance, biomedical waste management and automation in Haematology. It will also cover bone marrow examination, red cell anomalies, disorder of leucocytes, L.E. cell phenomenon.

Unit-1: Automation in Haematology: (10 Hrs.)

1. Safety precautions in Haematology
2. Principle of automated blood cell counter; Uses, care, maintenance and calibration of automated blood cell counter
3. Automatic ESR analyzer, urine analyzer
4. Coagulometer

Unit-2: Bone Marrow Examination: (10 Hrs.)

1. Composition and functions, Aspiration of bone marrow (Adults and children)
2. Processing of aspirated bone marrow (Preparation & staining of smear)
3. Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios)
4. Processing and staining of trephine biopsy specimens

Unit-3: Red Cells Indices: (10 Hrs.)

1. Red cell anomalies
2. Morphological changes such as variation in size shape & staining character.
3. MCV, MCH, MCHC & RDW
4. Reticulocytes: Definition, different methods to count, Absolute reticulocyte count

Unit-4: L.E Cells & Factors Deficiency: (10 Hrs.)

1. Lupus Erythematosus (L.E) cell phenomenon: Definition of L.E. cell.
2. Demonstration of L.E. cell by various methods & Clinical significance.
3. Quantitative assay of coagulation factors: Principle, Procedure
4. Screening of inhibitors

Unit-5: Cytochemical Stains Used in Haematology: (10 Hrs.)

1. Karyotyping: Chromosomal studies in hematological disorders (PBLC and Bone marrow)
2. Cyto-chemical staining: Principles, method and significance
3. PAS, SBB, NAP& MPO
4. Biomedical waste management in Haematology laboratory (Other than Radioactive material)

Learning Outcomes: They will be able to perform efficiently routine investigations in clinical hematology laboratory. Students will also be able to carry out different immune- hematological investigations and coagulation profile tests. They will be able to handle automated instruments.

Suggested Readings:

1. Text book of Medical Laboratory Technology by Praful 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

Subject Name: Applied Clinical Biochemistry-I
Subject Code: BMLS-503

Learning Objectives: The students will be taught about Hazards & safety measures in a clinical biochemistry lab, Quality control and quality assurance, Principles of assay procedures and Estimation of various Investigations in Biochemistry Lab.

Unit-1: **(10 Hrs.)**

1. Hazards & safety measures in clinical Biochemistry laboratory
2. Quality control and quality assurance in a clinical biochemistry laboratory
3. Laboratory organization
4. Management and maintenance of records

Unit-2: **(10 Hrs.)**

1. Principles of assay procedures, Normal range in blood, Serum, Plasma and Urine and reference values for: Glucose, Proteins
2. Urea, Uric acid
3. Bilirubin, SGOT & SGPT, ALP
4. Lipids

Unit-3: **(10 Hrs.)**

1. Principles, procedures for estimation & assessment of the following including errors involved and their corrections: Sodium, Potassium
2. Chloride, Iodine
3. Calcium
4. Phosphorous and Phosphates

Unit-4: **(10 Hrs.)**

1. Instruments for detection of Radioactivity
2. Applications of Radioisotopes in clinical biochemistry.
3. Enzyme linked immune sorbent assay (ELISA)
4. RIA

Unit-5: **(10 Hrs.)**

1. Acid base balance, action of buffer system
2. Hb buffers
3. Respiratory and metabolic acidosis, respiratory and metabolic alkalosis,
4. Arterial blood gas analysis, blood gas analyzer.

Learning Outcomes: They will be able to Diagnosis of clinical disorders by estimating biomarker, determine various substances including substrates, enzymes, hormones, etc. and their use in diagnosis and monitoring of disease are applied, evaluate the abnormalitieswhich commonly occur in the clinical field, rreview the information from each category of tests and develop a protocol for disease diagnosis

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

Subject Name: Applied Histopathology-II
Subject Code: BMLS-504

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

Unit-1: (10 Hrs.)

1. Cryostat sectioning, its applications in diagnostic histopathology.
2. Connective tissue stains and staining methods, properties, PTAH, Reticulin, verhoff
3. Masson trichrome, Ven Giesson, Heidemhain's Aniline Blue Method
4. Mucin: Types, various stains and staining methods PAS, alcian blue, Mucicarmine.

Unit-2: (10 Hrs.)

1. Lipids: Types, identification with various stains and staining method (Sudan, oil red O).
2. Pigments: Various pigments, identification with various stains methods and staining (hemosiderin melanin).
3. Miscellaneous (calcium) Vonkossa's Stains
4. Amyloid: -Toludineblue, Metachromatic Stains.

Unit-3: (10 Hrs.)

1. Identification of microorganisms using various stains. Modified Giemsa Stains, Silver Nitrate GMS.
2. Demonstration of Proteins & nucleic acids.
3. Tissue requiring special treatment i.e. eye ball, bone marrow, and muscle biopsy
4. Under calcified or unclarified bones, whole brain, and whole lungs including other large organs.

Unit-4: (10 Hrs.)

1. Immuno histochemical and immuno Cytochemical staining, quality control.
2. Enzyme histochemistry: Introduction, Diagnostic applications
3. Demonstration of Phosphatases, Dehydrogenases,
4. Demonstration of Oxidizes & Peroxidases.

Unit-5: (10 Hrs.)

1. Neuro-pathological techniques.
2. Museum techniques.
3. Electron Microscope: working principle and its components
4. Processing, embedding and ultra-microtomy

Learning Outcomes: Justify when to use cryopreservation to preserve tissue and how a cryostat functions; apply the correct stains to enhance particular cellular and tissue structures for examination; explain the underlying principles of microtomy and be able to apply them; and determine the features of common diseases under the microscope using the systems described above.

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

Subject Name: Immunology & Bacterial Serology- Practical
Subject Code: BMLS-505

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
5. Demonstration of antigen/antibody determination by Immuno fluorescence (IF)
6. Immunodiffusion, precipitation in Agarose gel (Ouchterlony)
7. CCIEP, ELISA, SDS - PAGE and Western blotting.

Subject Name: Applied Haematology-II- Practical
Subject Code: BMLS-506

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

Subject Name: Applied Clinical Biochemistry-I- Practical
Subject Code: BMLS-507

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.

Subject Name: Applied Histopathology-II- Practical
Subject Code: BMLS-508

1. To cut frozen section and stain for Hematoxylin and Eosin, Metachromatic stain Toluidine blue 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 stain a paraffin section for the demonstration of smooth muscle by Van Gieson ‘s Stain
4. To perform Masson‘s trichrome stain on a paraffin section for the demonstration of collagen fiber, muscle fiber and other cell elements.
5. To stain the paraffin section for the demonstration of the elastic fibers (EVG).
6. To stain Decalcified paraffin embedded section for the presence of calcium salts (Von Kossa‘s method).
7. To stain a paraffin section for the following Mucicarmine, Alcian blue.
8. To stain a paraffin section for the demonstration of iron (Perl‘s stain)
9. To demonstrate the presence of bacteria and fungi in paraffin embedded sections using
10. The following staining procedures:
    - 10.1 Gram ‘s staining
    - 10.2 AFB staining (Ziehl Neilson ‘s staining) for M. tuberculosis and leprae
    - 10.3 Grocott's ‘s stain for fungi
    - 10.4 Schmorl ‘s reaction for reducing substances (melanin)
    - 10.5 To stain for nucleic acid (DNA and RNA)
    - 10.6 11.1 Feulgen Staining
    - 10.7 Methyl Green-Pyronin Staining
    - 10.8 Enzymatic methods

Sixth Semester (31-36 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-601	Medical Parasitology & Entomology	3	1	-	30	70	100	4
BMLS-602	Advanced Hematology	3	1	-	30	70	100	4
BMLS-603	Applied Clinical Biochemistry – II	3	1	-	30	70	100	4
BMLS-604	Cytopathology	3	1	-	30	70	100	4
BMLS-605	Medical Parasitology & Entomology - (P)	-	-	4	30	70	100	2
BMLS-606	Advanced Hematology - (P)	-	-	4	30	70	100	2
BMLS-607	Applied Clinical Biochemistry – II- (P)	-	-	4	30	70	100	2
BMLS-608	Cytopathology - (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**12**	**6**	**16**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

Subject Name: Medical Parasitology & Entomology
Subject Code: BMLS- 601

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

Unit-1: Introduction to Medical Parasitology & Protozoology: (12 Hrs.)

1. Introduction to Medical Parasitology with respect to terms used in Parasitology.
2. Protozoology/ Protozoal parasites: General characteristics of protozoa.
3. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Entamoeba sp.
4. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Intestinal and vaginal flagellates i.e. Giardia, Trichomonas sp.
5. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of blood and tissue flagellates i.e. Plasmodium and Toxoplasma sp.

Unit-2: Helminthology/ Helminthic Parasites-I: (12 Hrs.)

1. General characteristics of Cestodes, Trematodes and Nematodes
2. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of: Taeniasolium and saginata
3. Echinococcusgranulosus, Hymenolepis nana
4. Chistosoma haematobium and mansoni

Unit-3: Helminthology/ Helminthic parasites-II: (12 Hrs.)

1. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of: Fasciola hepatica and buski
2. Trichuristrichura, Trichinellaspirales
3. Strongyloidesstercoralis, Ancylostomaduodenale, Enterobiusvermicularis
4. Ascarislumbricoides, Wuchereriabancrofti, Dracunculusmedinensis

Unit-4: Diagnostic Procedure-I: (12 Hrs.)

1. Examination of Stool for parasites for intestinal protozoal infections: Collection of stool samples, Preparation of material for unstained and stained preparations, staining methods i.e. Iodine staining and permanent staining
2. For Helminthic infections: Concentration techniques i.e. Flotation and sedimentation techniques, Egg counting techniques
3. Examination of blood for parasites: Preparation of thin and thick blood film, Leishman staining
4. Examination of thick and thin smear: Field ‘s stain, JSB stain

Unit-5: Diagnostic Procedure-II: (12 Hrs.)

1. Morphology, life cycle and lab-diagnosis of Malarial parasite with special reference to P. vivax and P. falciparum
2. Examination of blood film for Malarial parasite and Microfilariae
3. Laboratory diagnosis of hydated cyst and cysticercosis
4. Concentration techniques for demonstration of Ova and Cysts (Principles and applications)

LEARNING OUTCOME: Upon successful completion, students will have the knowledge and skills to:
On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Identify, describe and contrast unicellular parasites and parasitic worm
2. Prepare and observe live parasitic specimens and test students' own seropositivity for a particular parasitic infection
3. Report on observations of biological specimens such as parasites
4. Appraise the impacts of parasitic diseases on human societies
5. Assemble a presentation on a current topic in parasitology (literature research, selection of relevant sources of information, evaluation of the information/data, formulation of the research's results)

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
5. Microbiology For Medical Sciences by Bhagat Singh and Renu Singh

Subject Name: Advanced Haematology
Subject Code: BMLS- 602

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

Unit-1: Anaemias-I: (12 Hrs.)

Definition, causes, changes in blood morphology due to the following anaemias and special tests-

1. Iron deficiency anemia
2. Megaloblastic anaemia,
3. Aplastic anemia
4. Sideroblastic anaemia

Unit-2: Anaemias-II: (12 Hrs.)

Definition, causes, changes in blood morphology due to the following anaemias and special tests

1. Sickle cell anaemia, Autoimmune hemolytic anaemia,
2. Hereditary spherocytosis, G6PD deficiency anaemia
3. Thalassemia
4. Sickling test, Osmotic fragility test, Schilling test, Serum Iron, Iron binding capacity.

Unit-3: Leukemia: (12 Hrs.)

1. Definitions, morphology, identification of various abnormal cells in common Leukemia's
2. Acute Leukemia: AML, ALL
3. Chronic Leukemia: AML, CLL
4. Plasma cell myeloma.

Unit-4: Bleeding Disorders: (12 Hrs.)

1. Hemophilia A, B & Von-Willebrand disease
2. DIC,
3. Platelet disorder (Qualitative and quantitative)
4. Laboratory approach for investigating thrombosis.

Unit-5: Radioisotopes Measurement: (12 Hrs.)

1. Using radioisotopes measurement of: Blood volume
2. Determination of Red cell volume and Plasma volume
3. Red cell life span, Platelet life span
4. Radiation hazards and its prevention, Disposal of radioactive material

Learning Outcomes:

- Students will able to Differentiate and categorize the normal and abnormal morphology of the different cell types in the blood and bone marrow
- Analyze and compare the basic pathology related to these different abnormalities in the red and white blood cells
- Apply the basic knowledge in hematology for future professional training (e.g. Clinical Laboratory Scientist training program)
- Interpret the clinical and laboratory information to understand and classify different types of anemia.

Suggested Readings:

1. Text book of Medical Laboratory Technology by Praful 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 Hoff brand

Subject Name: Applied Biochemistry-II
Subject Code: BMLS- 603

Learning Objectives: 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.

Unit-1: Automation in clinical biochemistry: (12 Hrs.)

1. Automation in clinical biochemistry
2. Method of estimation and assessment for: Glucose tolerance test
3. Method of estimation and assessment for: Insulin tolerance test
4. Method of estimation and assessment for: Xylose excretion test.

Unit-2: Gastric analysis & Qualitative Test: (12 Hrs.)

1. Gastric analysis.
2. Clearance test for renal function.
3. Qualitative test for: Urobilinogens, Barbiturates
4. Ketosteroids

Unit-3: Organ Profile Test: (12 Hrs.)

1. Lipid Profile Test
2. Renal Function Test
3. Thyroid Function Test
4. Liver Function Test & Cardiac Function Test

Unit-4: Enzymes: (12 Hrs.)

5. Enzymes: Principles, Clinical significance and Procedures for estimation:
6. Acid phosphatase, Alkaline phosphatase
7. Lactate dehydrogenase
8. Aspartate transaminase
9. Alanine transaminase & Creatine phosphokinase

Unit-5: Body Cavity Fluid: (12 Hrs)

1. Qualitative analysis of Renal calculi.
2. Chemical examination of Cerebrospinal fluid.
3. Chemical examination of Ascetic fluid & Pleural Fluid.
4. Brief knowledge about rapid techniques in clinical biochemistry

Learning Outcomes: Students will know basics and procedure of different parameters used to assess organ function. The students will learn to perform assay of clinically important enzyme: serum alkaline phosphatase, serum Creatine phosphokinase and serum acid phosphatase.

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

Subject Name: Cytopathology & Cytotecniques
Subject Code: BMLS- 604

Learning Objectives: 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.

Unit-1: Introduction: (12 Hrs.)

1. Introduction, Definition, Branches of Cytopathology.
2. Aspiration cytology- Principles, indications and utility of the technique with special emphasis on role of cytotechnician in FNAC clinics
3. Equipments used in FNAC clinics.
4. Exfoliative Cytology- Principles, indications and utility of the technique, Sample collection, labelling, preparation, processing of cervical, endometrial, respiratory tract, gastro intestinal tract and urinary tract sample, Smear preparation.

Unit-2: Diagnostic Cytopathology: (12 Hrs.)

1. Fixatives and fixations: - types, uses, merits, demerits.
2. Cell Block preparation.
3. Cryostat sectioning, its applications in diagnostic cytopathology
4. Vital staining for Sex Chromatin

Unit-3: Enzyme Cytochemistry & Fluid Cytology: (12 Hrs.)

1. Enzyme Cytochemistry: Diagnostic applications
2. Demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases
3. Fluid Cytology: - Sample Collection, Assessment of smearing and staining
4. Urine, CSF, Body Fluids (Pleural, Pericardial, Ascitic).

Unit-4: Automation in Cytology & Staining: (12 Hrs.)

1. Liquid based cytology: Principles and preparation
2. Cytocentrifuge, molecular cytology
3. Immune-Cytochemistry
4. MGG & PAP Staining

Unit-5: Special Stains Used in Cytopathology: (10 Hrs.)

1. PAS
2. Alcian Blue
3. Mucicarmin
4. Giemsa, Sudan.

Learning Outcomes: Identifies various specimens and processing techniques employed in cytology Students will able to collect and proceed various Specimens in different sections of Cytopathology lab. The will able to used Automation in Cytopathology.

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

Subject Name: Medical Parasitology & Entomology- Practical
Subject Code: BMLS- 605

1. **Routine stool examination for detection of intestinal parasites with concentration methods:**
   1.1 Saline preparation

   1.2 Iodine preparation

   1.3 Floatation method

   1.4 Centrifugation method

   1.5 Formal ether method

   1.6 Zinc sulphate method

2. **Identification of adult worms from models/slides:**

   2.1 Tapeworm

   2.2 Tapeworm segments

   2.4 Ascaris (Round worm)

   2.4 Hookworms

   2.5 Pinworms

3. **Malarial parasite:**

   3.1 Preparation of thin and thick smears

   3.2 Staining of smears

   3.3 Examination of smears for malarial parasites (P. vivax and P. falciparum)

Subject Name: Advanced Haematology- Practical
Subject Code: BMLS- 606

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. Peripheral Blood Lymphocyte Culture for chromosome studies in Leukemia.

Subject Name: Applied Clinical Biochemistry-II- Practical
Subject Code: BMLS- 607

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

Subject Name: Cytopathology & Cytotecniques- Practical
Subject Code: BMLS- 608

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.

Seventh Semester (37-42 months)

Subject Code	Course Titles	Hours Per week			Marks			CR
		L	T	P	Internal	External	Total	
BMLS-701	Medical Virology & Mycology	3	1	-	30	70	100	4
BMLS-702	Blood Banking & Genetics	3	1	-	30	70	100	4
BMLS-703	Immunopathology & Molecular Biology	3	1	-	30	70	100	4
BMLS-704	Research methodology and Biostatistics	3	1	-	30	70	100	4
BMLS-705	Principles of Laboratory Management	3	1	-	30	70	100	4
BMLS-706	Medical Mycology and Virology - (P)	-	-	4	30	70	100	2
BMLS-707	Blood Banking & Genetics- (P)	-	-	4	30	70	100	2
BMLS-708	Immunopathology & Molecular Biology – (P)	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	2	-	-	-	-	2
Total		**15**	**7**	**12**	**240**	**560**	**800**	**26**
Total Hours in Semester		**550**						

Subject Name: Medical Virology & Mycology
Subject Code: BMLS-701

Learning Objectives: The student will be taught about introduction, general characteristics, life cycle and laboratory diagnosis of various medically important Viruses & Fungi.

Unit-1: Introduction to Virology: (12 Hrs.)

1. Introduction to medical virology, Introduction to medically important viruses.
2. Structure and Classification of viruses
3. Collection, transportation and storage of sample for viral diagnosis.
4. Staining techniques used in Virology

Unit-2: Virus Culture: (12 Hrs.)

1. Processing of samples for viral culture (Egg inoculation and tissue culture).
2. Modes of viral transmission: Persistent, non-persistent, vertical and horizontal
3. Viral multiplication and replication strategies:
4. Interaction of viruses with cellular receptors and entry of viruses. Assembly, maturation and release of virions.

Unit-3: Details of Viruses: (12 Hrs.)

1. Poxviruses, Herpesviruses, hepatitis viruses, retroviruses-HIV, Picorna viruses, rhabdoviruses
2. Orthomyxoviruses and paramyxo viruses, TORCH profile, Symptoms, mode of transmission, prophylaxis and control of Polio, Herpes, Hepatitis, Rabies, Dengue, HIV
3. Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis.
4. Introduction to oncogenic viruses, Types of oncogenic DNA and RNA viruses, concepts of oncogenes and proto-oncogenes
5. Prevention & control of viral diseases, antiviral compounds and their mode of action, interferon and their mode of action, General principles of viral vaccination

Unit-4: Introduction to Mycology: (12 Hrs.)

1. Introduction to Medical Mycology Basic concepts about superficial and deep Mycoses
2. Taxonomy and classification and general characteristics of various medically important fungi Normal fungal flora.
3. Techniques used for isolation and identification of medically important fungi.

4. Direct microscopy in Medical mycology laboratory, Processing of clinical samples for diagnosis of fungal infections i.e. Skin, nail, hair, pus, sputum, CSF and other body fluids.

Unit-5: Details of Fungi: (12 Hrs.)

1. Morphology, Diseases & lab diagnosis of: Candida, Dermatophytes, Mycetoma (Eumycetoma & Actionomycetoma), Cryptococcus, Histoplasmosis
2. Opportunistic Fungi, Blastomyces, coccidioidosis, Nocardia.
3. Methods for identification of yeasts and moulds, Dimorphism in fungi, Antifungal susceptibility tests.
4. Preservation of fungal cultures, Routine myco-serological tests and skin tests.

Learning Outcomes: Students will able to Explain viruses, fungi including their classification, morphology, and laboratory diagnosis and prevention measures, perform laboratory investigations for the diagnosis of infectious diseases caused by viruses, fungi, Discuss various viral fungal diseases of human.

Suggested Readings:

1. Practical Medical Microbiology by Mackie &MacCartney 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 Cheesbrough
6. Medical Mycology by Dr. JagdishChander
7. Microbiology For Medical Sciences by Bhagat Singh and Renu Singh

Subject Name: Blood Banking & Genetics
Subject Code: BMLS-702

Learning Objectives: Blood banking will make students learn about blood grouping &blood, Transfusion. The students will learn about the concept of blood grouping, compatibility testing in blood transfusion &screening of donated blood for various Infection Diseases. Genetics will make students learn about Fundamentals of Heredity. The students will learn about the concept of inheritance in various genetic diseases.

Unit-1: History & Discovery of Blood Group: (12 Hrs.)

1. History and discovery of blood group system
2. ABO and Rhesus blood group system
3. Cell and serum grouping
4. Various methods, interpretation of results.

Unit-2: Techniques: (12 Hrs.)

1. Discrepancies in blood grouping and resolving problems
2. Variants of D antigen and weak D typing.
3. Compatibility testing: - definition, indication methods.
4. Coombs test: - Direct, indirect, principle, procedure, interpretation, applications.

Unit-3: Blood Components: (12 Hrs.)

1. Blood component: Preparation, labeling, storage, cell separator
2. Preparation of packed cells and various fractions of blood for transfusion purposes.
3. Preparation of PRP, FP, FFP and Cryoprecipitate
4. Total quality management, documentation record keeping.

Unit-4: Transfusion Reactions: (12 Hrs.)

1. Transfusion reactions: Definitions, classification & Causes
2. Laboratory investigation of transfusion reactions and mismatched, transfusion reactions.
3. Compatibility tests in blood transfusion, complications and hazard of blood transfusion.
4. Transfusion transmissible diseases, screening methods (Sample collection, processing, handling and disposal).

Unit-5: Genetics: (12 Hrs.)

1. Continuity of life-heredity, variation
2. Mendel's laws of inheritance, Chromosomal basis of inheritance; other patterns of inheritance
3. 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, Human Genetics, Microbial genetics.

Learning Outcomes:

- Apply advanced blood bank and blood transfusion knowledge to make appropriate and effective on-the-job professional decisions.
- Perform and interpret commonly utilized procedures in the blood bank laboratory.
- Recognize normal and abnormal test results and correlate these data with appropriate pathologic conditions to accurately advise health care providers.
- Adapt immunohematology laboratory techniques and procedures when errors and discrepancies in results are obtained to effect resolution in a professional and timely manner.

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

Subject Name: Immunopathology & Molecular Biology
Subject Code: BMLS-703

Learning Objectives 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.

Unit-1: History & Introduction: (12 Hrs.)

1. Historical background, general concepts of the immune system,
2. innate and adaptive immunity; active and passive immunity
3. Primary and secondary immune response.
4. Cells and Organs of the immune system, Lymphoid organs of the Immune system, MHC I & II

Unit-2: Antigen & Antibody: (12 Hrs.)

1. Antigens and haptens: Properties, foreignness, molecular size, heterogeneity.
2. Antibodies: Historical perspective of antibody structure; structure, function and properties of the antibodies
3. Different classes, subclasses and biological activities of antibodies; concepts of antibody diversity, isotype, allotype,
4. Introduction of hybridoma technology, monoclonal antibodies, polyclonal antibody

Unit-3: HLA & Hypersensitivity: (12 Hrs.)

1. HLA Typing & Cross matching
2. Transplant Immunology.
3. Hypersensitivity: Definition, Types, Mechanisms, Autoimmunity
4. Immune tolerance: Basic concepts.

Unit-4: Molecular Biology: (12 Hrs.)

1. Introduction to Molecular Biology
2. Relationship of Mol. Biology with other Science.
3. Molecular Biology Techniques: Principle, Reagents used, procedure and applications in Medical diagnostics.
4. Polymerase Chain Reaction and its advanced versions, Gel electrophoresis, Western blot.

Unit-5: Molecular Biology: (12 Hrs.)

1. Chemical composition of DNA, DNA replication.
2. DNA damage and repair.
3. Regulation of prokaryotic and eukaryotic gene expression
4. Cell Cycle.

Learning Outcomes:

- Demonstrate the basic knowledge of immunological processes at a cellular and molecular level
- Define central immunological principles and concepts
- Outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and how they relate
- Elucidate the genetic basis for immunological diversity and the generation of adaptive immune responses
- Understand and explain the basis of immunological tolerance, autoimmunity and transplantation
- Exhibit a knowledge base in genetics, cell and molecular biology, and anatomy and physiology
- Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology

Suggested Readings:

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

Subject Name: Research Methodology & Biostatics
Subject Code: BMLS-704

Learning Objectives: The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.

Unit-1: (08 Hrs.)

1. Research Methodology: Introduction to research methods
2. Identifying research problem.
3. Ethical issues in research- Research design
4. Basic Concepts of Biostatistics.

Unit-2: (08 Hrs.)

1. Types of Data
2. Research tools and Data collection methods
3. Sampling methods
4. Developing a research proposal

Unit-3: (08 Hrs.)

1. Biostatistics: Need of biostatistics, what is biostatistics: beyond definition
2. Understanding of data in biostatistics
3. How & where to get relevant data, Relation between data & variables.
4. Type of variables: defining data set, Collection of relevant data: sampling methods.

Unit-4: (08 Hrs.)

1. Normal Distribution
2. Standard deviation, Standard errors.
3. Coefficient of Variation
4. t-test, Chi square test.

Unit-5: (08 Hrs.)

1. Construction of study: population, sample, normality and its beyond (not design of study, perhaps)
2. Summarizing data on the pretext of underlined study.
3. Understanding of statistical analysis (not methods)

Suggested readings:

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

Subject Name: Principles of Laboratory Management
Subject Code: BMLS-705

Learning Objectives: The objective of this module is to help the students will be made aware of the basic ethics, good lab practices including awareness/ safety in a clinical lab & aware various Accrediting body.

Unit-1: (10 Hrs.)

1. Ethical Principles and standards for a clinical laboratory professional duty to the patient, duty to colleagues and other professionals
2. Good Laboratory Practice (GLP), Introduction to Basics of GLP and Accreditation
3. Aims of GLP and Accreditation, Advantages of Accreditation
4. Brief knowledge about National and International Agencies for clinical laboratory accreditation

Unit-2: (10 Hrs.)

1. Awareness / Safety in a clinical laboratory, General safety precautions.
2. HIV: pre- and post-exposure guidelines, Hepatitis B & C: pre- and post-exposure guidelines,
3. Drug Resistant Tuberculosis Patient management for clinical samples collection, transportation and preservation.
4. Sample accountability, Purpose of accountability, Methods of accountability

Unit-3: (10 Hrs.)

1. Sample analysis: Introduction, factors affecting sample analysis.
2. Reporting results, basic format of a test report, reported reference range.
3. Clinical alerts, abnormal results, results from referral laboratories.
4. Release of examination results, alteration in reports

Unit-4: (10 Hrs.)

1. Quality Management system: Introduction, Quality assurance, Quality control system.
2. Internal and External quality control, quality control chart and importance of calibration and Validation of Clinical Laboratory instrument.
3. Ethics in Medical Laboratory Practice, Ethics in relation to Pre Examination procedures, Examination procedures, reporting of results, preserving medical records
4. Procurement of equipment and Inventory Control.

Unit-5: (08 Hrs.)

1. Audit in a Medical Laboratory.
2. Introduction and Importance, NABL & CAP.
3. Responsibility, Planning, Horizontal, Vertical and Test audit.
4. Frequency of audit, Documentation

LEARNING OUTCOME: Students would be competent enough to 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.

Suggested readings:

1. Teitz, (2007), Fundamentals of Clinical Chemistry,6th edition, Elsevier Publications
2. Bishop (2013), Clinical Chemistry,7th edition, Wiley Publications
3. Henry's Clinical Diagnosis and Management by Laboratory Methods, (2011),22ndedition, Elsevier

Subject Name: Medical Virology & Mycology-Practical
Subject Code: BMLS-706

1. To prepare culture media used routinely in mycology
2. To perform KOH preparation, Gram stain, Potassium Hydroxide - Calcofluor White method, India Ink preparation, Modified Kinyoun Acid Fast Stain for Nocardia, LCB preparation.
3. To identify given yeast culture by performing various identification techniques studied in theory.
4. To identify given mould culture by performing various identification techniques studied in theory.
5. To demonstrate dimorphism in fungi
6. To collect and process clinical samples for laboratory diagnosis of fungal infections i.e.

   6.1 Skin

   6.2 Nail

   6.3 Hair

   6.4 Body fluids and secretions
7. To demonstrate structure of viruses and their multiplication from charts etc.
8. To perform Giemsa stain, Seller's stain, immunofluorescent staining procedures for diagnosis of viral infections
9. Demonstration of fertilized hen egg
10. Demonstration of various inoculation routes in fertilized hen egg

Subject Name: Blood Banking & Genetics- Practical
Subject Code: BMLS-707

1. To prepare Acid Citrate Dextrose (ACD) and Citrate Phosphate Dextrose (CPD) Solutions
2. Screening of blood donor: physical examination including medical history of the donor
3. Collection and preservation of blood for transfusion purpose
4. Screening of blood for Malaria, Microfilaria, HBs Ag, Syphilis and HIV
5. To determine the ABO & Rh grouping 5.1 Direct or preliminary grouping

   5.2 Indirect or proof grouping

   5.3 Rh grouping and determination of Du in case of Rh negative
6. To perform Direct and Indirect Coomb ‘s test
7. To perform cross matching

   7.1 Major cross matching

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

Subject Name: Immunopathology & Molecular Biology-Practical
Subject Code: BMLT-708

1. Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
2. T and B cell separation
3. Immunofluorescence

   3.1 Anti- Nuclear Antibody (ANA)

   3.2 Anti- Neutrophil Cytoplasmic Antibody (ANCA)
4. AIDS Immunology and Pathogenesis (AIP)
5. Thyroid Microsomal antigen (TMA)- Agglutination reactions
6. Electrophoresis
7. Gel diffusion
8. Nephlometery
9. HLA

   9.1 Typing Serology & Cross match

   9.2 Molecular Typing
10. Nitro blue Tetrazolium Chloride Test (NBT)
11. FACS for CD4 and CD8
12. ELISA for lab. diagnosis of AIDS
13. Polymerase Chain Reaction and its advanced versions
14. Gel electrophoresis
15. Western blotting
16. Isolation of DNA and RNA
17. Estimation of DNA and RNA
18. Determination of molecular weight and quantification of DNA using agarose gel electrophoresis