MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

Mahatma Gandhi Institute of Allied Health Sciences

Syllabus

Bachelor of Medical Laboratory Science

4 years

(3 Years + 1 Year Internship)

Program Code: BMLS26

Duration- VIII Semesters (4 Years)

(B.MLS)

Principal
MG Institute of Allied Health Sciences
Jaipur

Dr. Bushra Fiza
Dean, Faculty of Allied and Healthcare Professions
MGUMST, Jaipur

2026-2027

Recommended by the BOS in Allied Health Sciences at its meeting held on 8th April, 2026, the Faculty of Allied and Healthcare Professions at its meeting held on 28.7.2026 and approved by Academic Council at its meeting held on 03.08.2026

NOTICE

1. The university reserves the right to make changes in the syllabus /books/ guidelines, fee-structure or any other information at any time without prior notice the decision of the university shall be binding on all.

2. The jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

3. This syllabus is aligned with the NCAHP Curriculum dated 15.10.2025 and Corrigendum dated 20.03.2026. Any subsequent amendments, revisions or corrigenda issued by the NCAHP shall automatically apply to the Rules, Regulations and Syllabus of MGUMST, Jaipur, and implemented accordingly.

References:

- https://ncahp.abdm.gov.in/Curriculum/MLS%20Curriculum%20NCAHP%202025%20Final.pdf
- https://ncahp.abdm.gov.in/Curriculum/CurriculumCorrigendum/Corrigendum-1MLS20March2026.pdf

Rules and Regulations of
Bachelor of Medical Laboratory Science (B.MLS)

- Program Code: **BMLS26**

1. **Title of the Program** - Bachelor of Medical Laboratory Science

2. **Duration of the Program-**Duration shall be for a period of 4 years (VIII semesters) including one year of internship.

3. **Medium of Instruction**- English

4. **Eligibility for Admissions**
   - The candidate must have passed Senior Secondary (10+2) or equivalent with Physics, Chemistry & Biology (Botany + Zoology) subjects.
   - Admission on the basis of merit of Senior secondary (10+2).
   - He/she has completed 17 years of age at the time of admission or will complete that age on or before 31 December of the year of his/her admission to the first year of the undergraduate Allied and Healthcare Course.
   - Lateral Entry to the candidates in second year (3rd semester) who have passed Diploma in Medical Laboratory Technology (D.MLT) with 50% marks.
   - Medical fitness certificate is mandatory to submit and it is to be endorsed by Government medical officer.
   - Foreign students' admission process in under graduate (UG):
     1) Foreign national students intending to study UG program
     2) in India, shall have to take equivalence certificate of eligibility certificate from respective State Allied and Healthcare Council.
     3) For Under Graduate admission of foreign national students, merit list will be based on University Entrance Exam.
     4) Verification of Valid Visa and valid visa duration of foreign national students, to be verified by respective institution & University before enrolling students for program.
   - The admission criteria shall be updated by the Commission from time to time.
   - Admission process shall be conducted by State/Union Territory/ University.

5. **Admission Process**- Selection shall be done by an admission board of the University/Rajasthan State Allied & Healthcare Council strictly on merit/written examination.

6. **Reservation Policy-** Reservation policy for admissions shall be as per the state/ Centre Government norms.

7. **Enrolment@**
   1. Every candidate who is admitted to the Bachelor of Medical Laboratory Science program in Mahatma Gandhi Institute of Allied Health Sciences shall be required to get himself/herself enrolled with the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST) after paying the prescribed eligibility and enrolment fees.
   2. A candidate shall deposit enrolment fee along with tuition fees at the time of his/her admission to the program. Such a candidate who fails to submit, to the college principal, duly filled enrolment form along with original documents including migration certificate required for enrolment within prescribed period then after he/she shall pay late fee applicable at that time. No student will be allowed to appear in the End of Semester Examination without his/her enrolment.

8. **Introduction –**

A medical laboratory professional (also referred to as a Medical Laboratory Technologist, A Clinical Laboratory Scientist or Clinical Laboratory Technologist) is a healthcare professional who performs chemical, hematological, immunologic, microscopic and microbiological diagnostic analyses on body fluids such as blood, urine, sputum, stool, cerebrospinal fluid (CSF), peritoneal fluid, pericardial fluid, and synovial fluid, as well as other specimens. Medical laboratory scientists work in clinical laboratories at hospitals, reference laboratories, biotechnology laboratories and non-clinical industrial labs.

a) Objectives/ Aim of the Program

- Equip students with knowledge of laboratory procedures across haematology, clinical biochemistry, microbiology, immunology, histopathology, and molecular diagnostics.
- Train students to operate, maintain, and troubleshoot modern diagnostic equipment.
- Emphasize quality control, laboratory safety, and ethical practice.
- Develop critical thinking and diagnostic interpretation skills.

1. Foundational Knowledge

- Understand the normal structure and function of the human body.
- Explain the pathophysiological basis of disease and how laboratory tests aid diagnosis.
- Apply knowledge of microbiology, hematology, biochemistry, immunology, and molecular biology to clinical scenarios.

2. Laboratory Skills

- Perform routine and specialized laboratory tests accurately in various disciplines (e.g., hematology, microbiology, clinical chemistry, histopathology).
- Operate, calibrate, and maintain laboratory instruments and equipment.
- Collect, handle, and process biological specimens following safety and quality standards.

3. Quality Assurance & Safety

- Implement quality control procedures to ensure accuracy and reliability of test results.
- Adhere to biosafety and infection control guidelines in all laboratory practices.
- Identify and troubleshoot pre-analytical, analytical, and post-analytical errors.

4. Critical Thinking & Problem Solving

- Analyze and interpret laboratory data for clinical relevance.
- Recognize abnormal results and understand their diagnostic implications.
- Apply logical reasoning to solve technical problems and improve procedures.

5. Communication & Collaboration

- Communicate effectively with healthcare professionals, patients, and laboratory teams.
- Maintain clear and accurate laboratory records and reports.
- Demonstrate professional and ethical behavior in a clinical setting.

6. Research & Lifelong Learning

- Understand the principles of scientific research and evidence-based practice.
- Participate in small-scale research or projects related to laboratory science.
- Stay updated with current advances in laboratory medicine and emerging technologies.

7. Professional Development

- Demonstrate responsibility, initiative, and time management in professional duties.
- Understand legal and ethical issues in laboratory practice.
- Prepare for national certification or licensing exams, if applicable.

b) Program Outcome:

Upon successful completion of the B.MLS program, students will be able to:

POs	Outcome
PO1	**Apply scientific knowledge** in professional healthcare practice.
PO2	**Demonstrate clinical and technical skills** to deliver quality healthcare services.
PO3	**Collaborate effectively in teams** within an interdisciplinary healthcare setting to improve societal health.
PO4	**Uphold ethical values and professionalism** within the legal framework of society.
PO5	**Communicate effectively** with healthcare teams and the community.

PO6	**Practice evidence-based medicine** to ensure high-quality professional performance.
PO7	**Engage in continuous learning** and adapt to technological advancements for professional growth.
PO8	**Exhibit entrepreneurial, leadership, and mentorship skills** for independent practice and collaborative work in healthcare.
PO9	Demonstrates an appropriate use of information and communication technology relevant to their field.
PO 10	**Takes responsibility for personal and professional development** and demonstrates an obligation to maintain competency by applying newly acquired knowledge or abilities to patient care

c) Program Specific Outcomes (PSOs)

POs	Outcome
PSO-1	Proficiently perform a full range of clinical laboratory tests, develop and evaluate test systems and interpretive algorithms and should be able to work on automated machines.
PSO-2	Manage information to enable effective, timely, accurate, and cost- effective reporting of laboratory-generated information and make specimen-oriented decisions on predetermined criteria, including working knowledge of critical values.
PSO-3	Process information and ensure quality control as appropriate to routine laboratory procedures.

d) Graduate Attributes

Upon graduation, students will possess the following attributes:

S.No.	Attribute	Description
1	**Knowledge and understanding**	Apply scientific knowledge and critical thinking in their field.
2	**Communication and Professionalism**	Communicate effectively with diverse audiences in various formats.
3	**Critical Thinking**	Analyse information and solve problems logically.

4	**Inquiry and Research**	Ask questions, investigate, and pursue new knowledge.
5	**Digital Literacy**	Use digital tools and technologies effectively and responsibly.
6	**Professionalism and Ethics**	Act ethically, responsibly, and professionally.
7	**Lifelong Learning**	Continuously seek and acquire new knowledge and skills.
8	**Leadership and Teamwork**	Lead and work effectively in diverse teams.
9	**Interdisciplinary Skills**	Work effectively across different fields of study.
10.	**Social Responsibility**	Contribute positively to society and understand global issues.
11	**Multi-cultural Competence**	Work respectfully and effectively in diverse cultural settings.
12	**Competence and Capability**	Perform their professional duties effectively and skillfully.

9. **Attendance –** A candidate has to secure minimum -

1. 80% attendance in theoretical

2. 80% in Skills training (practical) for qualifying to appear for the final examination. No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition etc.

Program Completion Timeline

- All academic coursework must be completed within a maximum of **double the program duration**.
- For example, in a **4-year program**, all requirements must be fulfilled within **8 years** from the commencement of the program.

Note: Failure to do so will result in **exit** from the program.

10. **Minimum Instruction/ Teaching Days** – (As per the program structure mentioned in point no.11)

11. Programme Structure (Semester I, II, III, IV_____*Distribution of courses semester wise)*

B.MLS FIRST SEMESTER

Course Code	COURSE NAME	Lecture (hr/wk)	Tutorial	Practical	Credits	Contact Hours
BMLS- 101	Human Anatomy	3	1	0	4	60
BMLS- 102	Human Physiology	3	1	0	4	60
BMLS- 103	Fundamentals of the Healthcare System and Medical Laboratory Science (MLS) #	2	0	0	2	30
BMLS- 104	Communication and Professionalism#	2	0	0	2	30
BMLS- 105	Basic Emergency care and First aid	1	1	0	2	30
BMLS- 106	Basics of Computer Application	1	0	1	2	45
BMLS- 107	Human Anatomy practical	0	0	4	2	60
BMLS- 108	Human Physiology practical	0	0	4	2	60
	Total	**12**	**3**	**9**	**20**	**375**

B.MLS SECOND SEMESTER

Course Code	COURSE NAME	Lecture	Tutorial	Practical	Credits	Contact Hours
BMLS- 201	Fundamentals of Microbiology	4	0	0	4	60
BMLS- 202	Basics of Biochemistry	4	0	0	4	60
BMLS- 203	Fundamentals of Hematology	4	0	0	4	60
BMLS- 204	Preventive and Social Medicine	2	0	0	2	30
BMLS- 205	Fundamentals of Microbiology Practical	0	0	4	2	60
BMLS- 206	Basics of Biochemistry Practical	0	0	4	2	60
BMLS- 207	Fundamentals of Hematology Practical	0	0	4	2	60
	Total	**14**	**0**	**12**	**20**	**390**

B.MLS THIRD SEMESTER

Course Code	COURSE NAME	Lecture	Tutorial	Practical	Credits	Contact Hours
BMLS- 301	Bacteriology	4	0	0	4	60
BMLS-302	Intermediary Metabolism and Endocrinology	4	0	0	4	60
BMLS- 303	Clinical Hematology	4	0	0	4	60
BMLS- 304	Basics of Pharmacology	2	0	0	2	30
BMLS- 305	Bacteriology Practical	0	0	4	2	60
BMLS-306	Intermediary Metabolism and Endocrinology Practical	0	0	4	2	60
BMLS- 307	Clinical Hematology-Practical	0	0	4	2	60
	Total	**14**	**0**	**12**	**20**	**390**

B.MLS FOURTH SEMESTER

Course Code	COURSE NAME	Lecture	Tutorial	Practical	Credits	Contact Hours
BMLS- 401	Virology and Immunology	4	0	0	4	60
BMLS- 402	Genetics and Molecular Biology	4	0	0	4	60
BMLS- 403	Clinical Pathology	4	0	0	4	60
BMLS- 404	Medical Laboratory Management and Quality Control	2	0	0	2	30
BMLS- 405	Virology and Immunology Practical	0	0	4	2	60
BMLS- 406	Genetics and Molecular Biology Practical	0	0	4	2	60
BMLS- 407	Clinical Pathology Practical	0	0	4	2	60
	Total	**14**	**0**	**12**	**20**	**390**

B.MLS FIFTH SEMESTER

Course Code	COURSE NAME	Lecture	Tutorial	Practical	Credits	Contact Hours
BMLS- 501	Mycology & Parasitology	4	0	0	4	60
BMLS- 502	Analytical Biochemistry	4	0	0	4	60
BMLS- 503	Immunohematology and Transfusion Medicine	4	0	0	4	60
BMLS- 504	Medical Law and Ethics	2	0	0	2	30
BMLS- 505	Mycology & Parasitology Practical	0	0	4	2	60
BMLS- 506	Analytical Biochemistry Practical	0	0	4	2	60
BMLS- 507	Immunohematology and Transfusion Medicine Practical	0	0	4	2	60
	Total	**14**	**00**	**12**	**20**	**390**

B.MLS SIXTH SEMESTER

Course Code	COURSE NAME	Lecture	Tutorial	Practical	Credits	Contact Hours
BMLS- 601	Applied Pathobiology	4	0	0	4	60
BMLS- 602	Cytology and Histopathology	4	0	0	4	60
BMLS- 603	Clinical Biochemistry	4	0	0	4	60
BMLS- 604	Biostatistics and Research Methodology	2	0	0	2	30
BMLS- 605	Cytology and Histopathology Practical	0	0	4	2	60
BMLS- 606	Clinical Biochemistry Practical	0	0	4	2	60
BMLS- 607	Applied Pathobiology Practical	2	0	0	2	60
	Total	**16**	**0**	**8**	**20**	**390**

B.MLS SEVENTH & EIGHTH SEMESTER

Course Name	Credit	Contact Hours
INTERNSHIP (clinical lab posting/research dissertation)	20+20	900+900
TOTAL	**40**	**1800**

Total credits = 160 credits

Total Contact hours = 4125

Contact hours of all semesters = (375+ 390+390+390+390+390) + (900+900)

Credit Details:

- Lecture / Tutorial: 1 credit = 15 hours
- Practical: 1 credit = 30 hours
- Clinical Lab postings: 1 credit = 45 hours

Credit Includes: L – Lectures, T - Tutorials, P - Practical.

12. Conduct of Continuous Assessment/ Internal Assessment –

Theory - 30 marks
Practical - 30 marks

There shall be a minimum of two periodical tests preferably one in each term in theory and practical of each subject in a semester. The average marks of the two tests will be calculated and reduced to 30.

Class participation/presentation	5 marks
Assignment & quizzes	5 marks
Sessional exams	20 marks

The marks of IA shall be communicated to the University at least 15 days before the commencement of the University examination. The University shall have access to the records of such periodical tests. The marks of the internal assessment must be displayed on the notice board of the respective colleges with in a fortnight from the date test is held. If a candidate is absent for any one of the tests due to genuine and satisfactory reasons, such a candidate may be given a re-test within a fortnight.

13. Dissertation/ Internship/ Project/ Clinical Postings

7th and 8th Semester: Internship (Lab posting/ Research dissertation):

A compulsory internship (Lab posting/ Research dissertation) of one year - equivalent to 12

months, 52 weeks, or 1800 hours - carrying 40 credits, must be completed by each student to be eligible for the award of the **Bachelor of Medical Laboratory Science (B.MLS).**

If a student opts for Research dissertation, it must be of a minimum duration of 6 months.

During the internship period, students are required to adhere to the rules and regulations of the host organization. Upon successful completion, students will receive an Internship Certificate that includes:

A summary of activities undertaken:

Details of clinical or relevant departmental postings with corresponding hours

Information on any research project completed during research dissertation
The certificate must be authenticated by the Dean/ Head of Department (HoD)/Coordinator and the Head of the Institution (HoI).

Note: The Bachelor's Degree will be awarded only upon successful completion of the Internship requirements.

14. **Scheme of Examination –**The end of semester examination for the program shall be conducted semester wise at the end of every semester.

MARKS DISTRIBUTION
B.MLS FIRST SEMESTER

Course Code	COURSE NAME	Continuous Assessment	End Semester Examination	Total
BMLS- 101	Human Anatomy	30	70	100
BMLS- 102	Human Physiology	30	70	100
BMLS- 103	Fundamentals of the Healthcare System and Medical Laboratory Science (MLS) #	15	35	50
BMLS- 104	Communication and Professionalism#	15	35	50
BMLS- 105	Basic Emergency care and First aid	30	70	100
BMLS- 106	Basics of Computer Application	30	70	100
BMLS- 107	Human Anatomy practical	30	70	100
BMLS- 108	Human Physiology practical	30	70	100
	TOTAL			**700**
	# Non-University Exams			

B.MLS SECOND SEMESTER

Course Code	COURSE NAME	Continuous Assessment	End Semester Examination	Total
BMLS- 201	Fundamentals of Microbiology	30	70	100
BMLS- 202	Basics of Biochemistry	30	70	100
BMLS- 203	Fundamentals of Hematology	30	70	100
BMLS- 204	Preventive and Social Medicine	30	70	100
BMLS- 205	Fundamentals of Microbiology Practical	30	70	100
BMLS- 206	Basics of Biochemistry Practical	30	70	100
BMLS- 207	Fundamentals of Hematology Practical	30	70	100
	Total			**700**

B.MLS THIRD SEMESTER

Course Code	COURSE NAME	Continuous Assessment	End Semester Examination	Total
BMLS- 301	Bacteriology	30	70	100
BMLS- 302	Intermediary Metabolism and Endocrinology	30	70	100
BMLS- 303	Clinical Hematology	30	70	100
BMLS- 304	Basics of Pharmacology	30	70	100
BMLS- 305	Bacteriology Practical	30	70	100
BMLS- 306	Intermediary Metabolism and Endocrinology Practical	30	70	100
BMLS- 307	Clinical Hematology- Practical	30	70	100
	Total			700

B.MLS FOURTH SEMESTER

Course Code	COURSE NAME	Continuous Assessment	End Semester Examination	Total
BMLS- 401	Virology and Immunology	30	70	100
BMLS- 402	Genetics and Molecular Biology	30	70	100
BMLS- 403	Clinical Pathology	30	70	100
BMLS- 404	Medical Laboratory Management and Quality Control	30	70	100
BMLS- 405	Virology and Immunology Practical	30	70	100
BMLS- 406	Genetics and Molecular Biology Practical	30	70	100
BMLS- 407	Clinical Pathology Practical	30	70	100
	Total			**700**

B.MLS FIFTH SEMESTER

Course Code	COURSE NAME	Continuous Assessment	End Semester Examination	Total
BMLS- 501	Mycology & Parasitology	30	70	100
BMLS- 502	Analytical Biochemistry	30	70	100
BMLS- 503	Immunohematology and Transfusion Medicine	30	70	100
BMLS- 504	Medical Law and Ethics	30	70	100
BMLS- 505	Mycology & Parasitology Practical	30	70	100
BMLS- 506	Analytical Biochemistry Practical	30	70	100
BMLS- 507	Immunohematology and Transfusion Medicine Practical	30	70	100
	Total			**700**

B.MLS SIXTH SEMESTER

Course Code	COURSE NAME	Continuous Assessment	End Semester Examination	Total
BMLS- 601	Applied Pathobiology	30	70	100
BMLS- 602	Cytology and Histopathology	30	70	100
BMLS- 603	Clinical Biochemistry	30	70	100
BMLS- 604	Biostatistics and Research Methodology	30	70	100
BMLS- 605	Cytology and Histopathology Practical	30	70	100
BMLS- 606	Clinical Biochemistry Practical	30	70	100
BMLS- 607	Applied Pathobiology Practical	30	70	100
	Total			**700**

B.MLS SEVENTH & EIGHTH SEMESTER

COURSE NAME	Continuous Assessment	End Semester Examination	Total
Lab Posting/ Research Dissertation (Logbook and Viva)	90	210	300
Lab Posting/Research Dissertation (Logbook and Viva)	90	210	300
Total			**600**

Note: ESE* will be conducted immediate after end of the 7th & 8th semester at the institutional level.

Credit Distribution: Each semester would consist of a minimum of 20 credits. The credit distribution hours for Lecture, Tutorial, Practical, and Clinics are as follows:

Credit Details:

Lecture / Tutorial: 1 credit = 15 hours; Practical: 1 credit = 30 hours; Clinical/ Lab Posting: 1 credit = 45 hours

Credit Includes: L – Lectures, T- Tutorials, P- Practical

Undergraduate Program Requirements: A minimum of **160** credits is required for the B.MLS. A program of 4 years duration, inclusive of a one-year internship (Lab posting /research dissertation).

15. Conduct of University Examination/ End of Semester Examination –

a) **Appointment of Examiners and Paper Setters (Qualification of paper Setters and Examiners):**
   - All the examiners, paper setters, theory examination answer book evaluators, external and internal examiners for practical examinations shall be appointed by the respective university.
   - Professor/Assoc. Professor/ Assistant Professor/Lecturer/Allied Health Professional having PG Qualification and 3 years professional /teaching experience after PG in respective fields or UG Qualification and 5 years professional industry/teaching experience after UG is eligible to act as an internal or external examiner of theory/practical examination.
   - For the 1st semester to 4th semester examination- respective theory question papers shall be set by the internal examiners covering their respective areas of syllabus. For each theory question paper, there shall be a separate internal examiner. The answer books shall be evaluated by the concerned internal examiners (paper setters).

- In the Vth and VIth semester examination, 25% of the theory question papers shall be set and evaluated by external examiners. The external examiner (paper setter) shall evaluate answer books of his/her theory paper.

b) **Eligibility to appear for the Examination**:
   - A student is required to have minimum 80% attendance in theory and practicals separately of each semester to make him/her eligible to appear in the university semester examination.
   - Candidates failing in one or more subjects (theory/practical) of semester will require to appear in failing subjects in the next examination of same semester.

c) Theory Examinations:
   - There shall be four Theory papers in each semester of study.
   - Each Theory paper examination shall be of 3 hours' duration and a maximum of 70 marks.
   - Internal assessment (IA) shall be 30 marks for each Theory paper.
   - The Paper Setter shall set the questions within the prescribed course of study of the concerned paper. There will be a set pattern of question papers duly approved by the Academic Council.

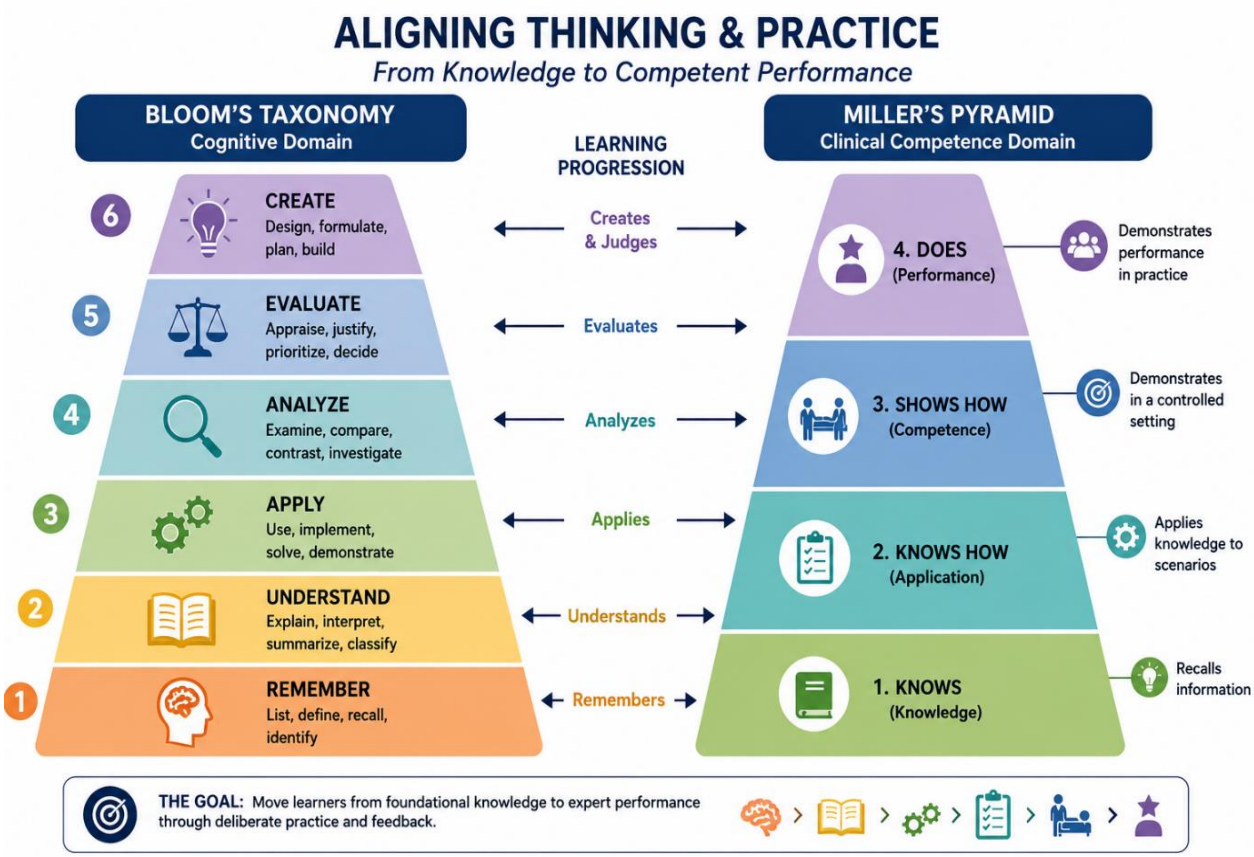
Proposed template of question papers –

MAXIMUM MARKS = 70		
TYPE OF QUESTION	NUMBER OF QUESTION	MARKS FOR EACH QUESTION
ESSAY TYPE	3 (to answer 2)	10
SHORT ESSAY TYPE	9 (to answer 7)	5
SHORT ANSWER TYPE	7 (to answer 5)	3

Passing Marks: A candidate will have to obtain at least 50% marks in each Theory paper including internal assessment to pass.

Bloom's Level: A blended approach—combining **didactic methods, experiential laboratory training, problem-solving, clinical immersion, and research exposure**—is essential in Medical Laboratory Sciences. When guided by educational frameworks such as **Bloom's Level,** these methodologies ensure that learners progress from acquiring foundational knowledge to demonstrating competence and ultimately practicing independently as professional laboratory scientists.

By weaving Bloom's Level (cognitive depth) the curriculum ensures that graduates not only master theoretical knowledge but also translate it into safe, accurate, and independent laboratory practice.



d) Practical Examinations and Viva Voce

- At the end of each semester there shall be the practical and viva-voce examination. It shall be conducted after the Theory examination is over. A candidate will have to obtain at least 50% marks in the practical and viva-voce examination.
  - For **First and Second Semester:** The practical examinations shall be conducted by one external examiner and one internal examiner appointed by the president of the university
  - From **Third Semester onwards:** The practical examinations shall be conducted by a panel consisting of two internal examiners and one external examiner to ensure comprehensive evaluation and transparency.

e) Results: A candidate will have to obtain at least 50% marks separately in each Theory paper including internal assessment and a minimum of 50% marks in the practical examination for him to be declared pass**.**

f) Supplementary Examination (MGUSMT RULES)[@]:

- Supplementary examination conducted by the University for unsuccessful candidates.
- Lower semester exams conducted along with current semester exams.
- Internal assessment can be improved before supplementary examination**.**

Grace Marks: The Award of grace marks shall be as per the policy governed by rules of MGUMST.

g) **Revaluation: (As per MGUMST Rules)**

Re- Evaluation of marks is permitted only for theory papers. The University/board, on application within the stipulated time and remittance of a prescribed fee, shall permit a Re- evaluation of marks for the course/s applied. The marks obtained after re- evaluation shall be the final marks awarded.

h) **Promotion to the next Semester**

Eligibility for promotion to the next academic year is based on the following minimum academic performance requirements:

- **First Year to Second Year:**
- A student must secure a minimum of **70% of the total credits** at the end of the first year (i.e., completion of both the first and second semesters).
- **Second Year to Third Year:**
- A student must secure a **cumulative minimum of 80% of the total credits** at the end of the second year (i.e., completion of the first to fourth semesters).
- **Third Year to Internship/Group Project:**

A student will be eligible to commence the **Internship (Lab posting/ Research Dissertation)** only after the **successful completion of all coursework**, i.e., **100% of the credits** must be earned by the end of the third year.

Letter Grades and Grade Points

Letter Grade	A+	A	B	C	D	E	F/I/DT
Credit value	10	9	8	7	6	5	0

F- Fail, DT - Detained/Attendance shortage, I – Incomplete

Internals Weightage (%)	**End semester Exam Weightage (%)**
30	70

Calculation of GPA & CGPA: An example is provided

Course code	Course	Credits (a)	Grade obtained by the student	Credit value (b)	Grade Points (a x b)
BMLS 1	Course - 1	4	D	6	24
BMLS 2	Course - 2	4	B	8	32
BMLS 3	Course - 3	3	A+	10	30
BMLS 4	Course - 4	4	C	7	28
BMLS 5	Course - 5	5	A	9	45
TOTAL		**20**	**-**	**-**	**159**

1st Semester GPA = Total grade points / total credits

159/20 = **7.95**

Suppose in **the 2nd semester, GPA** = **8.35** with respective course credit 20

$$Then, 1^{st}YearCGPA = \frac{\sum 7.95x20 \sum + \sum 8.35x20 \sum}{20 + 20} = 8.15$$

Credit Weightage Distribution

Item	Weightage (%)
Formative	
Class participation/presentation	5%
Assignment & quizzes	5%
Sessional exams	20%
Summative	
End-of-Semester University exam	70%
Total	100 %

Internals Weightage (%)	End semester Exam Weightage (%)
30	70

16. **Award of Degree[@]:** The degree shall be awarded by the university only after receipt of course completion certificate and No Dues from the principal of the college.

17. **Authority to issue transcript:** The Controller of Examination of the University shall be the authority for issuing transcript after receiving the described fee from the candidate.

18. **Logbooks and Clinical Records**:

- A compulsory internship (Lab posting/ Research dissertation) of one year - equivalent to 12 months, 52 weeks, or 1800 hours - carrying 40 credits, must be completed by each student to be eligible for the award of the Bachelor of Medical Laboratory Science (B.MLS).
- If a student opts for Research dissertation, it must be of a minimum duration of 6 months.
- During the internship period, students are required to adhere to the rules and regulations of the host organisation.
- Upon successful completion, students will receive an Internship Certificate that includes:

A summary of activities undertaken

Details of clinical or relevant departmental postings with corresponding hours

- Information on any research project completed during research dissertation
- The certificate must be authenticated by the Dean/ Head of Department (HoD)/Coordinator and the Head of the Institution (HoI).

19. Any specific point/ rule/ regulation related to college/ institute- NA

20. Course wise Syllabus with Recommended Text Books

21. Model Paper – Attached

QUESTION PAPER TEMPLATE FOR B.MLS SEMESTER I–IV

INSTRUCTIONS FOR PAPER SETTERS FOR B.MLS SEMESTER I–IV

1. All questions must be framed in alignment with the NCAHP framework. Map each question to the relevant Course Outcome (CO) and Bloom's taxonomy.
2. Every question must carry two mandatory annotations:(a) Course Outcome (CO): e.g., CO2, CO5;(b) Highest Bloom's Level Attained: e.g., L3 – Application. These must be written in brackets after the question text.
3. The Bloom's Taxonomy ceiling for B.MLS Semester I–IV is Level 3 – Application. No question in this paper shall exceed this level. The paper setter must self-audit using the Bloom's reference table provided in this template.
4. Question distribution across Bloom's levels [L1 – Knowledge; L2 – Comprehension; and L3 – Application] must be documented on the master copy. Recommended distribution for Semester I–IV:
   L1–L2: ~70–80%;
   L3: ~20– 30%;
   L4–L6: ~0% (not applicable).
5. Avoid repetition of topics across questions. Q1, Q2 and Q3 should collectively cover a minimum of 6–8 different topics/competencies to ensure adequate syllabus sampling.
6. All Long Answer Questions must carry sufficient internal scope. A 10-mark Long Answer Question should have 4–5 expected response components. These expected answers must be included in the model answer key submitted alongside the paper.
7. The paper setter must submit:
   (i) Question Paper with CO + Bloom's Level annotations;
   (ii) Model Answer Key with marking scheme.
   All documents are confidential and must be submitted in a sealed envelope to the Examination Cell.

B.MLS Semester I–IV: Question-Level Mapping Table (70 Marks)

Q. No.	Question Type	Bloom's Range
Q1	Long Answer (Attempt any 2 out of 3)	L1 – L3
Q2	Short Essay (Attempt any 7)	L1 – L3
Q3	Short Answer (Attempt any 5)	L1 – L2 only

Question Paper Structure:

Subject Code: BMLS……. **Subject Abb.**

Bachelor of Medical Laboratory Sciences

Semester
Subject Name

Time: 3 Hours
Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

a) …… (CO- , L-)
b)…… (CO- , L-)
c)…… (CO- , L-)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

a) …… (CO- , L-)

b) …… (CO- , L-)

c) …… (CO- , L-)

d) …… (CO- , L-)

e) …… (CO- , L-)

f) …… (CO- , L-)

g) …… (CO- , L-)

h) …… (CO- , L-)

i) …… (CO- , L-)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) …… (CO- , L-)
(b) …… ((CO- , L-)
(c) …… (CO- , L-)
(d) …… (CO- , L-)
(e) …… ((CO- , L-)
(f) …… (CO- , L-)
(g) …… (CO- , L-)

QUESTION PAPER TEMPLATE FOR B.MLS SEMESTER V–VI

INSTRUCTIONS FOR PAPER SETTERS FOR B.MLS SEMESTER V–VI

1. All questions must be framed in alignment with the NCAHP framework. Map each question to the relevant Course Outcome (CO) and NCAHP and Bloom's Taxonomy.
2. Every question must carry two mandatory annotations:(a) Course Outcome (CO): e.g., CO2, CO5;(b) Highest Bloom's Level Attained: e.g., L5.These must be written in brackets after the question text.
3. The Bloom's Taxonomy ceiling for B.MLS Semester V–VI is Level 5 – Evaluation. No question in this paper shall exceed this level. The paper setter must self-audit using the Bloom's reference table provided in this template.
4. Question distribution across Bloom's levels [L2 – Comprehension; L3 – Application; L4 – Analysis; and L5 – Evaluation] must be documented on the master copy.
   Recommended distribution:
   L2-L3: ~70–80%;
   L4: ~10–15%;
   L5: 5-10%
5. Avoid repetition of topics across questions. Q1, Q2 and Q3 should collectively cover a minimum of 6–8 different topics/competencies to ensure adequate syllabus sampling.
6. All Long Answer Questions must carry sufficient internal scope. A 10-mark Long Answer Question should have 4–5 expected response components. Clinical scenarios or case-based questions should be included wherever appropriate. These expected answers must be included in the model answer key submitted alongside the paper.

The paper setter must submit:
(i) Question Paper with CO + Bloom's Level annotations;
(ii) Model Answer Key with marking scheme.
All documents are confidential and must be submitted in a sealed envelope to the Examination Cell.

B.MLS Semester V–VI: Question-Level Mapping Table (70 Marks)

Q. No.	Question Type	Bloom's Range
Q1	Long Answer (Attempt any 2 out of 3)	L2 – L4
Q2	Short Essay (Attempt any 7)	L2 – L4
Q3	Short Answer (Attempt any 5)	L2 – L3 only

Question Paper Structure:

Subject Code: BMLS……. **Subject Abb.**

Bachelor of Medical Laboratory Sciences

Semester
Subject Name

Time: 3 Hours
Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

a) …… (CO- , L-)
b)…… (CO- , L-)
c)…… (CO- , L-)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

(a) …… (CO- , L-)

(b) …… (CO- , L-)

(c) …… (CO- , L-)

(d) …… (CO- , L-)

(e) …… (CO- , L-)

(f) …… (CO- , L-)

(g) …… (CO- , L-)

(h) …… (CO- , L-)

(i) …… (CO- , L-)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) …… (CO- , L-)
(b) …… (CO- , L-)
(c) …… (CO- , L-)
(d) …… (CO- , L-)
(e) …… (CO- , L-)
(f) …… (CO- , L-)
(g) …… (CO- , L-)

SEMESTER-I
Human Anatomy

Credit=4 (60 hours)

Course Rationale: Students will understand the structure and function of organs and organ systems in the human body.

Learning Objective: At the end of the course, students should be able to

● Comprehend the gross, functional and applied anatomy of various structures in the human body.

● Identify the microscopic structures of various tissues and organs in the human body and correlate the structure with the functions.

● Comprehend the basic structure and connections between the various parts of the central nervous system so as to analyse the integrative and regulative functions of the organs and systems.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Define and explain standard anatomical terminology, body cavities, planes, and basic embryological development.	L1, L2
CO2	Classify and describe the microscopic structure and characteristics of basic body tissues and the lymphatic system.	L2
CO3	Illustrate the structure, classification, and functional aspects of bones, muscles, joints, and the nervous system.	L2
CO4	Describe the gross anatomical structure, positions, and relations of organs in the respiratory, digestive, and excretory systems.	L2
CO5	Outline the structural features of the cardiovascular, endocrine, reproductive, and sensory systems.	L2
CO6	Identify major anatomical landmarks, organs, blood vessels, and tissue types relevant to laboratory sample collection and	L3

Course Content:

Unit	Topic	Hours
I.	**General Anatomy:** Introduction to Anatomy, terms and terminology. Regions of Body, Cavities and Systems. Surface anatomy – Musculoskeletal, vascular, cardio-pulmonary system. General Embryology.	4

II	**Tissues**- Classification and description of the basic tissues of the body. Histology: Epithelium, compact bone, muscles, connective tissue, nervous tissue, artery, vein and lymphatic tissue. Connective tissue & its modification, tendons, membranes, and special connective tissue.	4
III	**Musculoskeletal system:** • Bone structure, blood supply, ossification, and classification. • Muscle classification, structure, types and functional aspects. • Joints–classification, structures of joints, movements, range, blood supply, nerve supply, dislocations	8
IV	**Respiratory system:** Structure of the upper and lower respiratory tract. Thorax: Pleural cavities & pleura, Lungs and respiratory tree, Heart and great vessels, Diaphragm	6
V	**Digestive system –** Parts/Structure of digestive system, Abdominal cavity – divisions, Muscles of abdominal wall, Liver, Pancreas, Spleen, Alimentary canal, Gall bladder, Intestine (small & large), and accessory organs of digestion	6
VI	**Excretory System:** Anatomy of the Kidney. Structure of the kidney, ureter, urinary bladder, male and female urethra. General description of pelvic organs. **Lymphatic system**- Lymphatic vessels and lymph, lymph nodes, Spleen. Mediastinum – division and contents	6
VII	**Cardiovascular system:** Circulatory system – major arteries and veins of the body, structure of blood vessels, Heart structure, positions, chambers, valves, internal & external features, Blood supply to heart, Conductive system of heart	8
VIII	**Nervous system:** Classification of the nervous system. Nerve – structure, classification, microscopy with examples. Spinal cord- anatomy, structure and features of Meninges, Ventricles of the brain, CSF circulation	6
IX	**Sensory system:** Structure of the Visual system, Auditory system, Gustatory system, Olfactory system, Somatosensory system, Skin	6
X	**Reproductive system:** Structure of male and female reproductive organs. **Endocrine system:** Pituitary gland, Thyroid, Parathyroid	6
	Total	60

Practical: **Credit=2 (60 hours)**

Course Rationale: Students will be able to identify and demonstrate anatomical structures of various organ systems.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Define and identify anatomical planes, positions, and basic histological tissues.	L1, L2
CO2	Identify and demonstrate structures of skeletal, respiratory, digestive, and urinary systems using models and specimens.	L2, L3
CO3	Demonstrate and interpret anatomical features of cardiovascular and nervous systems.	L3, L4
CO4	Identify and apply knowledge of sensory organs, reproductive system, and anatomical landmarks in practical/clinical context.	L2, L4

Course content:

- Study of anatomical plans and positions
- Histological study of tissues
- Study of Skeletal system
- Study of respiratory system
- Study of digestive system
- Study of urinary system
- Study of Cardiovascular system
- Study of Nervous system
- Study of sensory organs: eye, ear, nose, tongue and skin
- Study of reproductive system

Suggested Readings:

- Ross and Wilson – *Anatomy and Physiology in Health and Illness*, 11th Ed., Elsevier
- Chaurasia B.D. – *Human Anatomy*, 7th Ed., CBS Publishers
- Gerard J. Tortora & Bryan H. Derrickson – *Principles of Anatomy and Physiology*, 14th Ed., Wiley
- Frank H. Netter – *Atlas of Human Anatomy*, 7th Ed., Elsevier
- Frederic H. Martini et al. – *Fundamentals of Anatomy and Physiology*, 9th Ed., Pearson
- Gray's Atlas of Anatomy – Richard Drake, Elsevier
- Manju Chugani & Preysi Chauhan – *Simplified Anatomy and Physiology for Paramedical Students*, Jaype

Human Physiology

Credit=4 (60 hours)

Course Rationale: Students will gain knowledge of the organisation of human body cells, tissues, blood and physiological functions of various organ systems of the human body.

Learning Objective: At the end of the course, students should be able to

- Understand the functioning of various organ systems of the body and their interactions
- Elucidate the physiological aspects of normal growth and development.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's
CO1	Describe and explain cell structure, organelles, membrane transport, and homeostasis.	L1, L2
CO2	Explain composition and functions of blood, hemoglobin, immunity, and hemostasis. Interpret blood groups, immunity, and immune responses in clinical context.	L2, L3
CO3	Describe and analyze nervous system, muscle physiology, synapse, reflexes, and ANS functions.	L2, L4
CO4	Explain respiration and digestion including regulation and physiological processes.	L2, L3
CO5	Describe renal, lymphatic, and cardiovascular functions and analyze regulation of blood pressure, cardiac cycle, fluid balance and immune functions.	L2, L4
CO6	Explain endocrine and reproductive physiology including hormonal regulation.	L2, L4

Course Content:

Unit	Topic	Hours
I.	**General Physiology**- Cell: morphology, structure and function of cell organelles, Structure of cell membrane, Transport across cell membrane, Intercellular communication, Homeostasis	4

II	**Blood**-Introduction-composition & function of blood, WBC, RBC, Platelets formation & functions, Immunity, Plasma: composition, formation & functions, Plasma Proteins:-types & functions, Blood Groups-types, significance, determination, Haemoglobin, Haemostasis.	4
III	**Nervous system and muscle:** Organisation of the nervous system. Structure and function of muscle and nerve cells. Functions of the brain, the Spinal cord, the cranial and spinal nerves, and the Motor system.Sensory system. ANS, Synapse, neuromuscular transmission reflex arc, reflex action and reflexes, Cerebrospinal fluid	8
IV	**Respiratory System:** General organisation, Mechanics of respiration, Regulation of respiration, Gaseous exchange in lungs and tissues, Pulmonary ventilation, volumes and capacities, Effect of exercise on respiration, hypoxia.	6
V	**Digestive System-**Digestion & absorption of nutrients, Gastrointestinal secretions & their regulation, Functions of Liver, pancreas & stomach, Gastrointestinal tract disorders	6
VI	**Renal System:** Functions of the kidney, urine formation, Glomerular filtration rate, clearance, Tubular function. Water excretion, concentration of urine-regulation of Na+, Cl-, K+ excretion, Physiology of urinary bladder	6
VII	**Lymphatic and immunological system:** Lymph glands and circulation of lymph, Spleen structure and function, Immunity – Formation of T-cells and B-cells, Antigen, Antibody and Immune response.	6
VIII	**Cardiovascular system:** Functions of the heart, organisation of the cardiovascular system, structure and properties of cardiac muscles. Cardiac output, cardiac cycle, and conducting system of the heart. Heart sounds, regulation of heart rate, pulse, blood pressure and its regulation. ECG, cardio- respiratory changes during exercise	8
IX	**Endocrine system-** Physiology of the endocrine glands – Pituitary, Pineal Body, Thyroid, Parathyroid, Adrenal, Gonads, Thymus, Pancreas. Hormones secreted by these glands, their classifications, and their functions.	8
X	**Male and female reproductive system:** Male: functions of testes & penis, pubertal changes in males, testosterone: action & regulations of secretion, ejaculatory mechanism & dysfunction Female: functions of ovaries and uterus, pubertal changes, menstrual cycle, oestrogens and progesterone action and regulation. Physiological changes during pregnancy, Placenta and placental circulation.	6
	Total	60

Practical: **Credit= 2 (60 hours)**

Course Rationale: Students will develop an understanding of the normal functioning of human organ systems and explain their physiological processes.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Perform and demonstrate basic clinical procedures including blood collection, hemoglobin estimation, and blood cell counts	L3
CO2	Prepare, stain, and interpret blood smears and identify cellular components.	L3, L4
CO3	Measure and interpret physiological parameters including blood pressure, pulse rate, and reflexes.	L3, L4
CO4	Demonstrate and analyze diagnostic procedures such as ECG, EMG, and spirometry (PFT).	L3, L4

Course content:

1. Perform blood collection
2. Estimation of Hemoglobin
3. Demonstrate blood cell count – RBC count and WBC count
4. Prepare blood smear and staining
5. Measure Blood pressure and Pulse Rate
6. Demonstration of ECG
7. Demonstration of EMG
8. Perform Reflexes testing
9. Spirometry and PFT (Pulmonary function test)

Suggested Readings:

- Guyton & Hall – *Textbook of Medical Physiology*, Elsevier
- C.C. Chatterjee – *Human Physiology*, Medical Allied Agency
- K. Sembulingam – *Essentials of Medical Physiology*, Jaypee
- Gerard J. Tortora & Bryan H. Derrickson – *Principles of Anatomy and Physiology*, 14th Ed., Wiley
- Ross and Wilson – *Anatomy and Physiology in Health and Illness*, 11th Ed., Elsevier

Basic Emergency care and First Aid

Credit=2 (30 hours)

Course Rationale: Students will be able to perform basic emergency procedures and provide first aid in everyday medical situations.

Learning Objective: At the end of the course, students should be able to

● Assess emergencies quickly and accurately to ensure personal and victim safety.

● Demonstrate basic life-saving techniques, including CPR (Cardiopulmonary Resuscitation) and the recovery position.

● Provide appropriate first aid for common injuries such as wounds, burns, fractures, sprains, and poisoning

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Define and explain the principles, aims, priorities, and golden rules of first aid.	L1 & L2
CO2	Describe the roles, qualities, and responsibilities of a first aider in emergency situations.	L2
CO3	Explain first aid measures for burns, haemorrhage, food poisoning, bites, and foreign body injuries.	L2
CO4	Describe the types, features, investigations, and initial management of shock and poisoning.	L2
CO5	Explain the chain of survival, vital signs, team dynamics, and principles of resuscitation.	L2
CO6	Demonstrate basic life support procedures, CPR techniques, pulse assessment, and bag-mask ventilation in adults and children	L3

Course Content:

Unit	Topic	Hours
I	First Aid-Introduction, Aims & objectives of first aid, Priorities of first aid, Golden rules of first aid, Qualities & responsibilities of first aider, Simple first aid measures in selected conditions like Food poisoning, Snake bite, Scorpion bite, Dog bite, foreign bodies in various organs, Burns, Haemorrhage	10

II	Shock- Definition, Types of shock, General Features of shock, Investigations of shock, Initial management & first aid of shock	4
III	Poisoning- Definition, Causes of poisoning, Sources of Poisoning, Symptoms of poisoning, First aid & Management, Antidotes, Common drugs poisoning, Carbon monoxide poisoning	4
IV	Introduction: Chain of survival, team dynamics & multi-rescuer resuscitation. Vital signs of patients- Body temperature, Pulse, Blood Pressure, Respiration	4
V	Basic Life Support (BLS) in adults: Flowchart approach, approach to victim, techniques of CPR, BLS in paediatric Victims: checking pulse in children, chest compressions techniques, Bag mask ventilation technique	8
	Total	30

Suggested Reading:

1. Manual of first aid, 1st edition, Gupta Abhitabh, 2012, Jaypee Publishers
1. Emergency medicine, 5th edition, SN Chugh, Ashimachugh 202, CBS publisher

Basics of Computer Application

Credit = 2 (1 credit theory = 15 hours; 1 credit practical = 30 hours)

Course Rationale: Students will be familiarised with computer operating systems, using Microsoft Office tools, and internet use in healthcare.

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Define and explain the generations, components, input-output devices, and applications of computers in healthcare.	L1 & L2
CO2	Describe the features of operating systems, file management, and basic user interface operations.	L2
CO3	Demonstrate the use of Microsoft Word for typing, formatting, tables, and inserting images in medical documents.	L3
CO4	Illustrate the use of Microsoft PowerPoint, Excel, and Access for presentations, data entry, formulas, and simple charts.	L2 & L3
CO5	Explain internet applications, computer networks, email usage, report attachment, and internet safety measures.	L2
CO6	Identify the role of computers in healthcare through electronic health records, hospital information systems, and laboratory	L3

Course Content:

Unit	Topic	Hours
I	Introduction to Computers: Generations of computers, Applications of computers, Parts of a Computer, I/O devices, computer uses in healthcare	3
II	Basics of Operating System: Introduction to OS, Features of Windows OS, File management, User interface basics	2
III	Microsoft Word and PowerPoint: Introduction to Word, Typing medical documents, formatting, tables, inserting images, Introduction to powerpoint, slide creation	3
IV	Microsoft Excel, Access: Introduction to Excel and Access, Entering data, basic formulas, formatting cells, simple charts	2
V	Internet & Email: Definition, types of network, using browsers, opening email, attaching reports, basic internet	2

	safety	
VI	Computers in Healthcare: Electronic health record, Hospital Information System basics, digital patient records, lab reporting usage	3
	Total	15

Practical **Credit:1 (30 hours)**

Course Rationale: This course enables students to gain practical computer literacy skills to create Word files, spreadsheets, and PowerPoint presentations

Course Outcome:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate document creation, formatting, tables, and printing using MS Word for healthcare documentation.	L3
CO2	Apply MS Excel functions for patient data entry, report preparation, formulas, and conditional formatting.	L3
CO3	Develop PowerPoint presentations and perform internet browsing, medical searching, and professional email	L4
CO4	Create patient databases using MS Access, HTML integration, and Artificial Intelligence tools for healthcare applications.	L4

Content:

1. MS Word – Document Creation- Resume, lab report typing, alignment, save & print
2. MS Word – Formatting & Tables- Medical charts, tables for patient information
3. MS Excel – Data Entry- Entering blood test reports and patient data
4. MS Excel – Basic Formulas- Average, sum, and conditional formatting
5. PowerPoint – Basic Slides- Creating a 5-slide presentation on hospital safety
6. Internet Browsing & Searching- Using Google for medical topics, downloading forms
7. Email Usage- Create an email, send a lab report with an attachment
8. MS Access database creation- Patient database creation
9. MS Access HTML integration in the database- Patient database creation view HTML webpage
10. Demonstrate use of Artificial Intelligence tools

Suggested Readings:

1. V. Rajaramana, *Computer basics and programming*, PHI Learning Pvt. Ltd.
2. Michael Miller, *Computer Basics and Absolute Beginner's Guide*, Que Publishing

Fundamentals of the Healthcare System and Medical Laboratory Science

Credit = 2 (30 hours)

Course Rationale: This course provides students with a comprehensive understanding of the Indian health care delivery system and the Clinical Laboratory in the health care system. Students will also understand the roles, responsibilities, and regulatory bodies of medical laboratory sciences.

Learning Objective: At the end of the course, students should be able to:

- Comprehend knowledge of the healthcare delivery system in India
- Identify the laboratory safety measures and biomedical safety management
- Understand the organisation, the importance of Clinical labs, Lab professionals and regulatory professional bodies

Course Outcomes:

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

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Define and explain the healthcare delivery system in India, levels of healthcare, and national health programs and policies.	L1 & L2
CO2	Describe the organization, classification, departments, and role of clinical laboratories in patient care.	L2
CO3	Explain laboratory safety measures including infection control, universal precautions, PPE, vaccination, and fire safety.	L2
CO4	Describe biomedical waste management practices and laboratory record maintenance as per healthcare standards.	L2
CO5	Illustrate the use of medical terminology, abbreviations, prefixes, suffixes, and electronic health record systems.	L2 & L3
CO6	Identify the roles and responsibilities of regulatory bodies and professional organisations related to healthcare and laboratory	L3

Course Content:

Unit	Topic	Hours
I	Introduction to healthcare delivery system - Healthcare delivery system in India at primary, secondary and tertiary care, classification of hospitals based on system of medicine, Community participation in healthcare delivery system, National Health Mission, National Health Policy, Issues in Health Care Delivery System in India	6
II	Visit to Clinical laboratories, Introduction to clinical Laboratory, Classification of Laboratory, Introduction to various sections/departments in clinical laboratories, Lab space and designing, Knowledge of lab organisational chart, Role of Laboratory in patient care	8
III	Lab safety measures- Infection control, Universal precautions, PPE, Vaccination, Chemical, physical, electrical and fire safety. Biomedical waste management	4
IV	Records and their importance in a hospital, Records maintained in the Laboratory as per ISO 15189, importance of records and reports, Data entry and management on an electronic health record system	3
V	Medical terminology - Derivation of medical terms, Basic medical terms, form medical terms utilizing roots, suffixes, prefixes, and combining roots, Interpret basic medical abbreviations/symbols	6
VI	Regulatory Bodies & Professional Organizations: Roles & Responsibilities – MoHFW, NCAHP, State Council, Registration	3
	Total	**30**

Suggested Readings:

1. Textbook of Medical laboratory Technology, Mirnali Sant, CBS publishers. 2022
2. Textbook of Medical laboratory Technology, Ramnik Sood, Jaypee Publishers, 2006
3. Textbook of Medical laboratory Technology, Godkar PB, Bhalani Publishing House, 2024

Communication and Professionalism

Course Rationale: The course comprises the study and development of the English language, listening, speaking, reading, and writing, which help students communicate well in academic and professional environments.

Learning Objective: At the end of the course, students should be able to:

- Develop good communication skills
- Trains the students in oral presentations, expository writing, logical organisation and structural support.
- Develops professionalism, understands professional ethics and values for professional success

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Define and explain the communication process, importance of communication, and barriers to effective communication.	L1 & L2
CO2	Describe the influence of perception, language, experiences, emotions, and environment on communication.	L2
CO3	Illustrate verbal, non-verbal, face-to-face, telephonic, and digital communication skills in professional settings.	L2 & L3
CO4	Demonstrate professional etiquette, grooming, time management, classroom behaviour, and workplace professionalism.	L3
CO5	Explain the preparation of resumes, CVs, presentation skills, and interview techniques for career development.	L2
CO6	Identify professional and personal values including integrity, confidentiality, accountability, ethics, hygiene, and mental well-	L3

Course Content:

Unit	Topic	Hours
I	Communication Skills: The Importance of Communication, The Communication Process. Barriers to communication: Physiological, Physical, Cultural, Language, Gender, Interpersonal, Psychological and Emotional barriers	4
II	Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment. Elements of Communication: Introduction, Face-to-Face Communication, Tone of Voice, Body Language (Non-verbal communication), Verbal Communication.	4

III	Developing personal etiquette: personal appearance, importance of grooming, acknowledging and respecting, maintaining professionalism, cubicle etiquette, time management, attending classes, meetings, seminars, etc, table manners, greeting, Netiquette and Telephonic conversation	4
IV	Developing presentation and career skills: Introduction, Importance of Resume and CV, preparing Resume and CV, Interview Skill Tips, FAQ During Interviews, Mock interviews	8
IV	Professional values - Integrity, Objectivity, Confidentiality, Professional competence and due care, professional risks, professional responsibility, accountability, professional success	3
V	Personal Values - Ethical and Moral values, Attitude and behaviour, Personal Hygiene and Mental Health	3
	Total	30

Suggested Readings:

1. Graham Lock, Functional English Grammar: Introduction to Second Language Teachers. Cambridge University Press, New York, 1996.
2. Gwen Van Servellen. Communication for Health care professionals: Concepts, practice and evidence, Jones & Bartlett Publications, USA, 2009

SEMESTER-II

Fundamentals of Microbiology

Credit =4 (60 hours)

Course Rationale: Students will acquire knowledge on the Historical Development of Microbiology, various types of microscopes, bacterial anatomy and staining methods, sterilisation methods, culture media, culture methods, biochemical tests and antibiotic susceptibility tests, and understand the underlying concepts of bacterial genetics and its applications in recombinant DNA technology.

Learning Objective: At the end of the course, students should be able to

- Comprehend knowledge of Microscopes, their types and applications
- Explain microbial structure, physiology, growth, and reproduction.
- Identify common methods used in the control and prevention of microbial growth and infection.
- Demonstrate knowledge of aseptic techniques and basic microbiological laboratory procedures.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's
CO1	Define and explain the historical development of microbiology, major contributors, and the role of microorganisms in disease.	L1 & L2
CO2	Describe the principles, types, and applications of microscopy used in microbiological investigations.	L2
CO3	Illustrate the morphology, structure, staining characteristics, physiology, and genetics of bacteria.	L2
CO4	Explain sterilisation, disinfection, culture media, bacterial culture methods, and isolation techniques used in microbiology	L2
CO5	Describe the methods of bacterial identification, taxonomy, biochemical testing, automated systems, and antibiotic	L2
CO6	Identify normal microbial flora, sources and transmission of infections, and epidemiological concepts in clinical	L3

Course Content:

Unit	Topic	Hours

I	Historical Development of Microbiology: Infection and Contagion, Discovery of Microorganisms, Conflict over Spontaneous Generation, Role of Microorganisms in Diseases, Scientific Development of Microbiology - Louis Pasteur, Joseph Lister, Robert Koch, Paul Ehrlich, Edward Jenner, Ignaz Semmelweis, Antony van Leeuwenhoek.	3
II	Microscopy: Light Microscopy, Bright-field microscopy, Dark- ground microscopy, Phase-contrast microscopy, Fluorescence microscopy, Electron microscopy	7
III	Morphology of Bacteria: Comparison of Prokaryotic Cells– Eukaryotic cells, size of bacteria, arrangement of bacterial cells, Anatomy of the bacterial cell- the structure, function, and clinical significance of - Cell wall, Cell membrane, Cell surface appendages, Bacterial Capsule, Cell organelles, plasmid, Spore. Principles of staining - Simple staining, Negative staining, Differential staining, Gram's and acid-fast staining, Albert's, Flagella staining, Capsule staining, Endospore staining	7
IV	Physiology of Bacteria: generation time of bacteria, bacterial growth curve, bacterial nutrition, bacterial metabolism	6
V	Bacterial Genetics: Different gene transfer methods: Transformation, Transduction, Lysogenic conversion, Conjugation.	5
VI	Sterilisation and Disinfection: Classify sterilisation methods - Dry heat sterilisation, Moist heat sterilisation, Radiation, Filtration. Disinfection- Classify disinfectants, general features of disinfectants - Alcohols and aldehydes, Dyes, halogens and phenols - Gases, surface active agents and metallic salts, Testing of disinfectants - Rideal Walker method, Chick Martin test, Disinfectant kill time test, Kelsey- Sykes test, In-use test, Advanced techniques in Sterilisation of Heat- Sensitive Articles.	7
VII	Culture Media and Methods: Culture Media- common ingredients of culture media, classification of media. Culture Methods- Methods of bacterial culture, aerobic culture, anaerobic culture, methods of anaerobiosis, methods of isolating pure cultures.	5
VIII	Identification of Bacteria: Methods used to identify bacteria, phenotypic characteristics, genomic characterisation, Bacterial Taxonomy-Taxonomy, Identification, classification systems, Identification of Bacteria by biochemical tests and automated systems: - Bac T alert and BACTEC systems, -VITEK and Phoenix systems - RTPCR, MALDI-TOF	8
IX	Antibiotic susceptibility testing (AST): A. Diffusion methods 1. Kirby–Bauer disk diffusion method 2. Stokes disk diffusion method B. Dilution methods 1. Broth dilution method 2. Agar dilution method. Epsilometer or E-test, Minimum inhibitory concentration (MIC) and Minimum	6

	bactericidal concentration (MBC) of antibiotics,	
X	Human Normal Microbial Flora and Microbiome: Microbial Infections- Microorganisms and Host, Infection and Infectious Disease, Classification of Infections, Sources and Modes of Transmission of Infection, Epidemiological Terminologies	6
	Total	60

Practical:

Credit:2 = 60 hours

Course Rationale: Students will acquire knowledge to demonstrate and perform basic microbiological tests in the identification of microorganisms.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate microscopy techniques, staining procedures, and morphological identification of bacteria in clinical microbiology laboratories.	L3
CO2	Apply sterilization, disinfection, culture media preparation, and bacterial cultivation methods for microbiological investigations.	L3
CO3	Analyze bacterial growth characteristics, biochemical reactions, identification methods, and antibiotic susceptibility testing results for diagnostic interpretation.	L4
CO4	Evaluate microbial laboratory practices, automated identification systems, infection control measures, and quality assurance procedures for reliable microbiological reporting.	L5

Course Content:

1. Demonstrate the collection of various clinical specimens and their transport and processing.
2. Demonstrate a safe code of practice in the Microbiology laboratory
3. Demonstrate cleaning and sterilisation of glassware
4. Perform microscopy and specimen processing
5. Operate the autoclave and hot air oven, including its efficacy testing.
6. Demonstrate the sterilisation of reagents and culture media
7. Demonstrate sterilisation of media/solution by filtration.

8. Demonstrate the proper precautions to take when using disinfectants and dilution of commonly used disinfectants.

9. Demonstrate Simple staining

10. Demonstrate Gram's staining

11. Demonstrate Preparation of stains, reagents and culture media, quality control of reagents and media, and sterility check

12. Identify QC strains used for culture media *Clinical laboratory rotation/observation can be incorporated wherever possible

Suggested reading

- Mackie & McCartney – *Practical Medical Microbiology*, Elsevier
- Bailey & Scott – *Diagnostic Microbiology*, Elsevier
- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- Surinder Kumar – *Essentials of Microbiology*, Jaypee Brothers Medical Publishers
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- Lansing M. Prescott – *Microbiology*, McGraw-Hill
- Apurba Sankar Sastry & Sandhya Bhat K – *Essentials in Medical Microbiology*, Jaypee Brothers Medical Publishers
- Praful B. Godkar & Darshan P. Godkar – *Textbook of Medical Laboratory Technology*, Bhalani Publishing

Basics of Biochemistry

Credit =4 (60 hours)

Course Rationale: Students will learn the basic concepts of Biochemistry, chemistry of carbohydrates, proteins, lipids, nucleic acids, enzymes, vitamins, minerals and nutritional requirements.

Learning Objective: At the end of the course, students should be able to

● Describe the structure and function of key biomolecules, including carbohydrates, proteins, lipids, and nucleic acids.

● Explain the fundamental principles of enzyme action, including enzyme kinetics, inhibition, and regulation.

● Demonstrate knowledge of biochemical techniques used to analyse biomolecules.

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's
CO1	Discuss the fundamental concepts of biochemistry, laboratory solutions, pH, buffers, and biophysical phenomena used in	L1 & L2
CO2	Classify carbohydrates and lipids based on their structure, properties, biological importance, and metabolic significance.	L2
CO3	Outline the chemistry, classification, structural organization, and functions of amino acids and proteins.	L2
CO4	Interpret the structure and biological role of nucleic acids and explain the classification and mechanism of enzyme action.	L2
CO5	Summarize the classification, biochemical functions, dietary requirements, deficiency disorders, and toxic manifestations of vitamins and minerals.	L2
CO6	Apply the principles of nutrition, energy requirements, balanced diet, glycaemic index, and nutritional disorders in healthcare	L3

Course Content

Unit	Topic	Hours

I.	**Introduction to Biochemistry:** Units of weight and volume, Preparation of solutions (percentage, Molarity, Normality), Basic concepts of acids, bases, and buffers, their application in the Laboratory. Definition and determination of pH. Preparation of distilled water, double-distilled water, and deionised water. Fundamental concepts on biophysical phenomena like osmosis, dialysis, colloidal state, viscosity, adsorption, osmotic pressure, and surface tension.	4
11	**Chemistry of Carbohydrates**: Introduction to carbohydrates, biological importance of carbohydrates, classification, physical and chemical properties	7
III	**Chemistry of lipids:** Introduction to lipids, biological importance of lipids, Classification of lipids, Physical and chemical properties, Cholesterol and lipoproteins	7
IV	**Chemistry of Amino acids & Proteins:** Introduction to amino acids, biological importance of Amino acids, classification of amino acids. Introduction to proteins, the biological importance of proteins. Classification of proteins, Structural organisation of Proteins, Physical and chemical properties of Proteins and Amino acids	10
V	**Chemistry of Nucleic acids**: Introduction to Nucleic acids, nucleotides, nucleosides, biological importance of Nucleic acids, Structure of DNA and RNA, Difference between DNA and RNA	8
VI	**Chemistry of Enzymes:** Introduction of enzymes, classification of enzymes, Coenzymes and Cofactors, Active site, Mechanism of action, Factors influencing enzyme action, Enzyme inhibition and regulation.	8
VII	**Vitamins & Minerals:** Introduction to vitamins, Classification, RDA, Chemistry and biochemical function, deficiencies and toxic manifestations Introduction to minerals, Classification, RDA, Chemistry and biochemical function, deficiencies and toxic manifestations, Special references to calcium, phosphorus, magnesium, iron, zinc and copper	12
VII1	**Nutrition:** Calorie Requirements, SDA and BMR, Respiratory Quotient, Glycemic Index, Balanced Diet and Energy Calculations, Formulation of diet and dietary fibre, Starvation, obesity, and Protein Energy Malnutrition	4
	Total	60

Practical:

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate preparation of laboratory solutions, buffers, distilled water, and determination of pH using standard biochemistry laboratory procedures.	L3
CO2	Apply qualitative and quantitative techniques for identification and analysis of carbohydrates, lipids, proteins, amino acids, and nucleic acids.	L3
CO3	Analyze enzyme activity, factors affecting enzyme action, and the biochemical significance of vitamins and minerals in laboratory investigations.	L4
CO4	Evaluate nutritional parameters, energy calculations, dietary formulations, and biochemical findings related to metabolic and nutritional disorders.	L5

Course Name: Basics of Biochemistry- **Practical Credit =2 (60 hours)**

Course rationale: Students will learn the essential laboratory practices, which include the Preparation of Lab reagents and qualitative analysis of carbohydrates, proteins and lipids.

1. Demonstrate the use of Laboratory Apparatus, Micropipettes, and their uses
2. Demonstrate cleaning of glassware
3. Demonstrate the use of a laboratory balance
4. Prepare and label common Laboratory reagents (Percentage, Molarity, Normality)
5. Preparation of distilled water, double-distilled water, and deionised water.
6. Measure pH for laboratory reagents/ biological samples
7. Perform qualitative analysis of carbohydrate and identification of unknown carbohydrate- Molisch test, Benedict test, Modified Bareford test, Seliwanoff test, Bial test, Mucic acid test, Iodine test, Foulger's test, osazone test
8. Perform qualitative analysis of protein and amino acids- Precipitation test - Heat and acetic acid Test, Heller's test, alkali, alcohol, Isoelectric point precipitation. Colour reaction – Ninhydrin, Nitroprusside test, Xanthoproteic test, Million test, Sakaguchi test
9. Perform qualitative analysis of lipids – Solubility test

Suggested Readings:

- U. Sathyanarayana – *Biochemistry*, Elsevier
- Robert K. Murray et al. – *Harper's Illustrated Biochemistry*, Tata McGraw-Hill
- M.N. Chatterjee & Rana Shinde – *Textbook of Medical Biochemistry*, Jaypee
- Alan Gowenlock – *Varley's Practical Clinical Biochemistry*, CBS
- David L. Nelson & Michael M. Cox – *Lehninger Principles of Biochemistry*, W.H. Freeman
- D.M. Vasudevan – *Textbook of Biochemistry*, Jaypee
- A.C. Deb – *Fundamentals of Biochemistry*, New Central Book Agency
- Y.K. Joshi – *Basics of Clinical nutrition*, Jaypee publishers

Fundamentals of Hematology

Credit=4 (60 hours)

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

Learning Objective: At the end of the course, students should be able to

- Understand the composition of blood and the function of blood cells.
- Identify the normal and abnormal blood cells \, viz erythrocytes, leucocytes and thrombocytes
- Comprehend the process of hemostasis and its physiological properties
- Demonstrate knowledge of haematological techniques used to analyse basic parameters in the Laboratory

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's
CO1	Explain the composition of blood, hematopoiesis, bone marrow structure, and methods of bone marrow collection.	L1 & L2
CO2	Describe the structure, function, lifespan, and abnormalities of erythrocytes with their clinical significance.	L2
CO3	Illustrate the synthesis, functions, variants, and estimation methods of hemoglobin in health and disease.	L2
CO4	Discuss the structure, functions, disorders, and normal ranges of leucocytes and thrombocytes.	L2
CO5	Interpret the mechanisms of Hemostasis, coagulation, fibrinolysis, haematocrit, and erythrocyte sedimentation rate.	L2
CO6	Apply the principles of automation, quality assurance, anticoagulants, blood collection, and Romanowsky staining in	L3

Course Content

Unit	Topic	Hours

I	Introduction to blood, composition and function of normal cellular components. Haematopoiesis: Site of haematopoiesis, Bone marrow and Bone marrow collection; Cellular ratio, bone marrow biopsy and aspiration techniques and their indications for collection	10
II	Erythrocytes: Normal Structure, Function, and Fate of Erythrocytes along with Clinical Indications of Jaundice, Normal Range. Abnormal Red Blood Cells: Anisocytes, Poikilocytes, and their clinical significance Hemoglobin: Structure, composition and function, synthesis and regulation of hemoglobin, oxygen association and dissociation curve Various types of hemoglobin with clinical significance - Fetal hemoglobin, Meth-hemoglobin, Sulf-haemoglobin, Carboxyhemoglobin, Sickle hemoglobin, Glycosylated hemoglobin, different methods of estimation	10
III	Leucocytes: Structure, functions, normal range, lifespan of normal White Blood Cells. Quantitative and qualitative disorders of White Blood Cells: physiological and pathological causes	**10**
IV	Thrombocytes: Structure, functions, normal range, lifespan of normal Platelets. Quantitative disorder of Platelets: physiological and pathological causes Normal hemostasis and physiological properties of coagulation factors. Primary, secondary and tertiary hemostasis. Role of the platelets, coagulation factors, coagulation inhibitory system and fibrinolysis.	**10**
V	Hematocrit and Erythrocyte Sedimentation Rate: **p**hysiological and pathological causes	**5**
VI	Automation in Haematology lab: principles and analysis Quality assurance in Haematology, Internal and external quality control, including reference preparation, Routine quality assurance protocol, Statistical analysis, i.e. Standard deviation, Coefficient of variation, accuracy and precision	**8**
VII	Anticoagulants: types, mode of action and preference of anticoagulants for different haematological studies. Different types of blood collection, including the preservation of blood samples for various haematological investigations. Principles of Romonowsky stain with examples and its applications	**7**
	Total	**60**

Practical: Credit: 2 (60 hours)

Course Rationale: Students will acquire comprehensive knowledge and skills in fundamental laboratory techniques and patient safety. They will understand and apply knowledge regarding sample collection, transport, storage, and preservation. Perform laboratory investigations using appropriate methods and instruments, while adhering to safety protocols and equipment care.

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate blood collection techniques, specimen preservation methods, anticoagulant usage, and Romanowsky staining procedures in hematology laboratory practice.	L3
CO2	Apply laboratory methods for the assessment of erythrocytes, hemoglobin, leukocytes, platelets, hematocrit, and erythrocyte sedimentation rate.	L3
CO3	Analyze peripheral blood and bone marrow findings to identify normal and abnormal hematological parameters and correlate them with clinical conditions.	L4
CO4	Evaluate automation-based hematology investigations, quality control measures, and laboratory practices to ensure accurate and reliable test results.	L5

Course Content:

1. Demonstrate laboratory safety and biomedical waste management
2. Pre-analytical variables in clinical Laboratory: Patient and test request form identification, Patient preparation for phlebotomy, Sources of error in venous blood sample collection
3. Sample transport, processing, Sample acceptance and rejection criteria
4. Perform blood collection and demonstrate the order of draw
5. Estimation of hemoglobin by Drabkin's method
6. Perform Packed Cell Volume
7. Perform ESR by the Westergren method
8. Stain and examine the blood smear using Romanowsky stain
9. Perform Differential Leucocyte Count
10. Perform RBC count
11. Perform WBC count
12. Perform Absolute Eosinophil count
13. Perform Platelet count

14. Calculation of Red Cell Indices
15. Perform Bleeding Time and Clotting Time
16. Operate automated cell counters and interpret results
17. Perform Reticulocyte count

Suggested books

- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.
- Dacie, J. V. (2006). *Dacie and Lewis practical haematology*. Elsevier Health Sciences.
- Firkin, F., Chesterman, C., Rush, B., & Pennigton, D. (2008). *De Gruchy's Clinical haematology in medical Practice*. John Wiley & Sons.
- McPherson, Richard A.. (2022). *Henry's clinical diagnosis and management by laboratory methods, 24th ed.* (24). : Elsevier.
- M.D., H, T., M.D, H, D. (2004). Color Atlas of Hematology Practical Microscopic and Clinical Diagnosis. New York: Thieme.
- Greer, J. P., Arber, D. A., Glader, B., & List, A. F. (2018). Wintrobe's clinical hematology (14th ed.). Wolters Kluwer.
- Kanai, L Mukherjee, (2010). Medical Laboratory Technology, CBS publishers

Preventive and Social Medicine

Credit:2 = 30 hours

Course Rationale: Through this course, students learn the principles of primary health care, the significance of health programs, and the role of communication and education in behaviour change. The inclusion of first aid and patient care in communicable diseases prepares allied health professionals to actively contribute to health promotion and disease prevention at all levels of healthcare delivery.

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Discuss the principles of epidemiology, epidemiological triad, reservoirs, carriers, nosocomial infections, and disinfection	L1 & L2
CO2	Outline the principles of primary health care, national health programmes, occupational health, and the role of NGOs in healthcare delivery.	L2
CO3	Describe demographic concepts, population control measures, family welfare programmes, and contraceptive methods.	L2
CO4	Interpret the causes, effects, and preventive measures of environmental pollution and biomedical waste management	L2
CO5	Explain the principles of health education, communication, behavioural change communication, and interpersonal relationships in healthcare settings.	L2
CO6	Apply first-aid measures, CPR techniques, isolation methods, and universal precautions in the care of patients with	L3

Course Content:

Unit	Topic	Hours
I.	**Basic Epidemiology:** Epidemiological Triad, Carrier, Reservoir, Host for infection and diseases, Various methods of disinfection used at each level of healthcare, Incubation period, Nosocomial Infections	03
II.	**Primary Health Care:** Principles, Elements, Health Programmes - Maternal and Child Health, Nutrition, Environment, older adults, Central Government Health Schemes, Occupational Health, Voluntary Health Agencies, Role of NGOs in the Health Team.	07

III	**Demography and Family Welfare:** Definition, Demographic cycle, Population Explosion, Factors influencing population growth, death rate, birth rate, and methods of contraception. Family Welfare – Definition, Objectives of Family Planning. Types: Temporary and Permanent methods, Follow-up of contraceptive methods, Family planning counselling.	03
IV	**Environmental Health:** Air Pollution, Noise Pollution, Water Pollution, with the causes, effects, and preventive measures. Solid Waste Management - Swachh Bharat Abhiyan, Nirmal Bharat Abhiyan. Biomedical Waste Management Rules 2016 - colour coding and disposal into correctly colour-coded bags. Disease Elimination and Disease Eradication: Examples.	07
V	**Communication and Health Education:** Health education–definition, principles, objectives, purpose, types, and AV aids. Communication–definition, process, and types. Behavioural change communication. IEC (Information, education, and communication): aims, scope, concept, and approaches. First-aid–Definition, Principles, Golden rules, and bandages. First-aid for fracture, bleeding, drowning, Convulsions, Foreign Bodies, poisoning, Shock, and Cardio- Pulmonary Resuscitation. Role and skill of health professional in Health Education; Interpersonal relationship: coordination and cooperation in health education with other members of the health team.	08
VI	**Patient care in Communicable Diseases:** Care of patients with communicable diseases, Isolation methods, Standard safety measures (Universal precautions). Role and skill of the Health professional in the management of patients with communicable diseases.	02
	Total	**30**

Suggested Readings

- Textbook of Preventive and Social Medicine – J.E.Park
- Manual for Laboratory Technician – 1985. DGHS, Ministry of Health, Govt of India

SEMESTER-III

Bacteriology

Credits: 4 = 60 hours

Course Rationale: Students will identify medically important bacteria, understand their pathogenic mechanisms, and apply diagnostic methods for bacterial infections and hospital-acquired infections.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Identify the morphology, classification, and pathogenic characteristics of Gram-positive bacteria and Mycobacteria relevant to human infections.	L1 & L2
CO2	Describe the classification, infections, and laboratory diagnosis of anaerobes including spore-forming and non-spore-forming bacteria.	L2
CO3	Explain the morphology, pathogenicity, and clinical significance of Gram-negative cocci and Enterobacteriaceae associated with infectious diseases.	L2
CO4	Illustrate the characteristics and laboratory identification of Vibrio, Pseudomonas, Burkholderia, Spirochetes, Mycoplasma, Actinomycetes, Nocardia, and Candida species.	L2
CO5	Apply microbiological principles in the identification and laboratory diagnosis of skin, respiratory, gastrointestinal, urinary, cardiovascular, central nervous system, and genital tract infections.	L3
CO6	Demonstrate the principles of prevention, investigation, and control of nosocomial infections along with bacteriological examination of air, food, water, and milk.	L3

Course Content:

Unit	Topic	Hours
I	Gram-positive bacteria: Staphylococcus species, Streptococcus species, Corynebacterium diphtheriae, Bacillus species	8
II	Mycobacteria: Classification and morphology	4

III	Anaerobes: Non-spore-forming anaerobes. Classify anaerobes, infections caused, and laboratory diagnosis of non-sporing anaerobes	5
IV	Spore-forming anaerobes: Classify Clostridia species: Clostridium perfringens, Clostridium tetani, Clostridium botulinum, Clostridium difficile	5
V	Gram Negative Cocci: Neisseria meningitidis, Neisseria gonorrhoeae	5
VI	Enterobacteriaceae: Escherichia coli, Klebsiella species, Proteus species, Salmonella species, Shigella species	10
VII	Vibrio species, Pseudomonas and Burkholderia. Spirochetes: Classification of Spirochetes - Treponema pallidum, Leptospira, Borrelia	8
VIII	Mycoplasma, Actinomycetes and Nocardia, Candida	5
IX	Types of infections & diagnosis - Skin and soft tissue infections, Respiratory tract infections, Cardiovascular System & Central Nervous System infections, Otitis media, Gastrointestinal tract infections, Urinary tract infections, Genital tract Infections	6
X	Nosocomial Infection - Hospital Acquired Infections (HAI), risk factors, sources and route. Investigation, prevention and control of hospital-acquired infections. Bacteriology of air, food, water and milk	4
	Total	60

Bacteriology Practical:

Credit:2= 60 Hours

Course Outcomes: Students will demonstrate and perform bacterial culture, identification, and antibiotic susceptibility testing using manual and automated methods.

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate staining, culture, isolation, and identification techniques for common pathogenic bacteria in clinical microbiology laboratories.	L3
CO2	Apply standard laboratory procedures for processing and diagnosis of respiratory, urinary, gastrointestinal, skin, bloodstream, and central	L3

	nervous system infections.	
CO3	Analyze biochemical reactions, serological findings, and antibiotic susceptibility testing results for identification of clinically important microorganisms.	L4
CO4	Develop quality control practices and interpret microbiological findings obtained through manual and automated diagnostic methods for accurate bacteriological reporting.	L4

Course content:

1. Perform pure culture study of common pathogens. (Staphylococcus aureus, Staphylococcus pyogenes, Enterococcus species, Corynebacterium diphtheriae, E. coli, Salmonella spp, Shigella spp, Pseudomonas, Proteus spp, K. pneumoniae, Vibrio cholerae, Pseudomonas aeruginosa, C. albicans).

2. Apply diagnostic Scheme for Respiratory Tract Infections.

3. Apply diagnostic Scheme for Urinary Tract Infections.

4. Apply diagnostic for Gastrointestinal Tract Infections.

5. Apply diagnostic for Central Nervous System Infections and Bacteraemia

6. Apply diagnostic for Skin Infections.

● (demonstrate specimen processing by manual method, including specimen receiving, Specimen inoculation into appropriate culture media, using appropriate staining method, biochemical reactions, and serological grouping for aerobic bacteria)

7. Demonstrate bacterial identification and antibiotic susceptibility testing using manual /automated methods

8. Processing of specimens for anaerobic bacteria

9. Processing of specimens for mycobacteria

10. Perform serological tests for the diagnosis of bacterial diseases

11. Identify the quality control used in the manual and automated methods

Suggested Reading

- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- C.P. Baveja – *Textbook of Microbiology*, Arya Publications
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- Dubey R.C. – *A Textbook of Microbiology*, S. Chand Publishers

- Arora D.R. – *Textbook of Microbiology,* CBS Publishers
- Apurba Sankar Sastry & Sandhya Bhat K – Essentials in Medical Microbiology, Jaypee Brothers Medical Publishers
- Mackie & McCartney – *Practical Medical Microbiology*, Elsevier
- Henry D. Isenberg – *Clinical Microbiology Procedures Handbook*, ASM Press
- Bailey & Scott – *Diagnostic Microbiology*, Elsevier
- Koneman et al. – *Colour Atlas and Textbook of Diagnostic Microbiology*, Lippincott

Intermediary Metabolism & Endocrinology

Credit =4 (60 hours)

Course Rationale: To familiarise the students with the metabolism of carbohydrates, lipids, proteins, nucleic acids, haemoglobin and minerals. Students will also gain knowledge of the basics of endocrinology.

Learning Objective: At the end of the course, students should be able to

- Explain the fundamental principles of metabolism, including anabolic and catabolic pathways.
- Describe the key metabolic pathways such as glycolysis, the citric acid cycle (TCA cycle), oxidative phosphorylation, and beta-oxidation.
- Understand the regulation of metabolic pathways and the role of enzymes, cofactors, and hormones in metabolic control.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom 's Level
CO1	Explain the digestion, absorption, and metabolic pathways of carbohydrates including glycolysis, TCA cycle, glycogenesis, and gluconeogenesis.	L2
CO2	Describe biological oxidation, electron transport chain, oxidative phosphorylation, and their role in energy production.	L2
CO3	Illustrate lipid metabolism including beta-oxidation, cholesterol metabolism, ketogenesis, and associated metabolic disorders.	L2
CO4	Explain protein and amino acid metabolism, urea cycle, and inherited disorders associated with amino acid metabolism.	L2
CO5	Apply the principles of integrated metabolism, mineral metabolism, and water-electrolyte balance in clinical conditions.	L3
CO6	Describe purine, pyrimidine, haemoglobin, and hormone metabolism along with functions of major endocrine glands and mechanisms of hormone action.	L1 & L2

Course Content:

Unit	Topic	Hours
I	**Metabolism of carbohydrates**: Digestion and absorption, Glycolysis, TCA cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis, Significance of HMP shunt and uronic acid pathway. Regulation of blood glucose. Disorders of Carbohydrate metabolism: Diabetes mellitus, glycosuria, glycogen storage diseases, galactosemia, pentosuria, fructosuria.	9
II	**Biological oxidation and Electron transport chain:** Redox potentials, Biological oxidation and high-energy compounds, organisation of electron transport chain, Chemiosmotic theory, ATP synthase, inhibitors of ATP synthase, uncouplers of oxidative phosphorylation.	6
III	**Metabolism of lipid:** Digestion and absorption, Beta-oxidation of fatty acids, Synthesis and breakdown of cholesterol, lipoproteins, and ketogenesis. Disorders of lipid metabolism: Hyperlipidemia, hyperlipoproteinemias, Atherosclerosis, fatty liver	8
IV	**Metabolism of protein and amino acid:** Digestion and absorption, transamination, Oxidative and non-oxidative deamination, Urea cycle, Creatine synthesis and degradation, Metabolism of aromatic amino acids. Disorders of Protein metabolism and amino acid metabolism: Inherited disorders associated with the urea cycle, Phenylketonuria, Alkaptonuria	9
V	**Integration of Metabolism**: Metabolism in a well-fed state and starvation. **Mineral metabolism:** Regulation of the blood level of calcium, phosphorus and iron. **Water and electrolyte balance:** Distribution of fluids in the body, water metabolism, factors influencing the distribution of body water, thirst mechanism, intake and loss of body water, electrolyte distribution, function and regulation, and dehydration.	6
VI	**Purine and Pyrimidine metabolism**: Biosynthesis of purines, pyrimidines, Breakdown of purine and pyrimidines	8
VII	**Hemoglobin metabolism**: Oxygen dissociation curves and abnormal haemoglobin, formation and breakdown of hemoglobin.	6

VIII	**Hormones:** Introduction, Classification, Major endocrine glands and their hormones, Hypothalamus, Pituitary, Thyroid, Parathyroid, Adrenal cortex, Pancreas and gonads. Mechanism of action of hormones.	8
	Total	**60**

Intermediary Metabolism & Endocrinology Practical Credit =2 (60 hours)

Course Rationale: Students will be taught a relevant diagnostic test and gain hands-on experience in estimating biochemical parameters using standard kit methods used in laboratories

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate operation, calibration, and maintenance of colorimeter and spectrophotometer used in clinical biochemistry laboratories.	L3
CO2	Apply standard biochemical methods for estimation of glucose, proteins, lipids, renal function markers, calcium, and serum electrolytes.	L3
CO3	Perform qualitative urine analysis and specialized biochemical investigations for diagnostic evaluation of clinical samples.	L3
CO4	Analyze biochemical parameters, calculated indices, and laboratory findings to interpret clinical significance and ensure quality laboratory practices.	L4

Course Content:

1. Operate the colorimeter and spectrophotometer
2. Estimation of Plasma Glucose by GOD - POD method
3. Estimation of Total Protein by Biuret Method
4. Estimation of Albumin by the BCG method. Calculation of A/G ratio
5. Estimation of Cholesterol by modified CHOD-POD method
6. Estimation of Urea by Urease method
7. Estimation of Uric acid by uricase method
8. Estimation of creatinine by picric acid method

9. Demonstration of serum electrolytes

10. Estimation of Calcium

11. Perform qualitative urine analysis - 5-hydroxy indole acetic acid (HIAA), total porphyrins, Coproporphyrin

Suggested Readings:

- U. Sathyanarayana – *Biochemistry*, Elsevier
- Robert K. Murray et al. – *Harper's Illustrated Biochemistry*, Tata McGraw-Hill
- M.N. Chatterjee & Rana Shinde – *Textbook of Medical Biochemistry*, Jaypee
- Alan Gowenlock – *Varley's Practical Clinical Biochemistry*, CBS
- David L. Nelson & Michael M. Cox – *Lehninger Principles of Biochemistry*, W.H. Freeman
- D.M. Vasudevan – *Textbook of Biochemistry*, Jaypee
- A.C. Deb – *Fundamentals of Biochemistry*, New Central Book Agency
- Y.K. Joshi – *Basics of Clinical nutrition*, Jaypee publishers
- Nader Rifai et al, *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,* Saunders / Elsevier

Clinical Haematology

Credit:4 =60 Hours

Course Rationale: Students will understand the pathophysiology and laboratory diagnosis of haematological disorders, including anaemia, leukocyte abnormalities, coagulation defects, and related morphological changes in blood cells.

Learning objective: At the end of the course, students should be able to

- Comprehend knowledge of Qualitative and Quantitative disorders of Erythrocytes, leucocytes and thrombocytes
- Describe the pathophysiology and clinical features of common pathological diseases
- Demonstrate the proper techniques for specimen collection, handling, and diagnosis of the pathological diseases

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain red cell indices and their application in the laboratory diagnosis of different types of anaemia.	L2
CO2	Describe the etiology, pathophysiology, clinical features, and laboratory findings of common anaemias and hemoglobin disorders.	L2
CO3	Illustrate the classification, clinical manifestations, and laboratory diagnosis of acute and chronic leukemias, polycythemia vera, and multiple myeloma.	L2
CO4	Apply coagulation pathways and interpret hematological investigations including PT, INR, APTT, TT, fibrinogen, platelet count, D-dimer, and factor assays in bleeding and clotting disorders.	L3
CO5	Demonstrate the laboratory diagnosis of haemostatic disorders including Hemophilia, Von Willebrand disease, DIC, ITP, and platelet function disorders.	L3
CO6	Identify the principles and clinical applications of cytogenetics, karyotyping, FISH, chromosome analysis, and flow cytometry with CD markers in hematological malignancies.	L1 & L2

Course Content:

Unit	Topic	Hours
I.	Red cell indices: Definition, normal range, and calculations with their application in diagnosing anaemia	**5**
II.	Anaemia - Morphological and etiological classification: Signs, symptoms, aetiology, pathophysiology, and laboratory findings associated with Iron deficiency anaemia, Megaloblastic anaemia, Aplastic anaemia, Hemolytic anaemia, Thalassemia, Sickle cell anaemia, Hereditary spherocytosis, Paroxysmal nocturnal hemoglobinuria. Recent advances in laboratory diagnosis of anaemia	**16**
III	Leukaemia: Leukaemia: Leukemoid reaction- Definition and clinical implications, Leukaemia- Classification, definition and clinical implications, Pathophysiology, signs, symptoms, and laboratory diagnosis of Acute lymphoid leukaemia (ALL), Acute myeloid leukaemia (AML), Chronic lymphoid leukaemia (CLL), Chronic myeloid leukaemia (CML). Pathophysiology, signs, symptoms, and laboratory diagnosis of Polycythemia vera, Multiple Myeloma. Recent advances in laboratory diagnosis of leukaemia	**16**
IV	Haemostasis Disorders: Coagulation pathways- Extrinsic and Intrinsic Cell-Based Model of Coagulation. Coagulation Tests and Interpretation of Prothrombin, PT/INR, Activated Partial Thromboplastin Time (APTT), Thrombin Time (TT), Fibrinogen, Platelet, D-dimer test, Mixing study, and factor assay Pathophysiology, signs, symptoms, and laboratory diagnosis of common bleeding / clotting disorders - Haemophilia A & B, Von-Willebrand disease, Bernard-Soulier syndrome, Glanzman's thrombasthenia, Disseminated intravascular coagulation (DIC), Immune Thrombocytopenic Purpura (ITP). Recent advances in laboratory diagnosis of coagulation disorders	**16**
V	Cytogenetics, Karyotyping, FISH, chromosome analysis for interpretation of malignancies	**4**
VI	Basics of Flow Cytometry with CD markers	**3**
	Total	**60**

Clinical Haematology **Practical Credit: 2 = 60 hours**

Course Rationale: Students will gain practical skills necessary for various laboratory investigations required for the diagnosis of hematological disorders and compare them with normal values and clinical conditions.

Course Outcomes

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate preparation, staining, and microscopic examination of peripheral blood smears for identification of normal and abnormal blood cell morphology.	L3
CO2	Apply hematological procedures including reticulocyte count, bone marrow examination, and laboratory evaluation of hematological disorders.	L3
CO3	Perform diagnostic investigations for hemoglobinopathies, hemolytic disorders, coagulation abnormalities, and platelet function assessment.	L3
CO4	Analyze hematological findings, coagulation profiles, and laboratory data for clinical interpretation and quality assurance in hematology laboratories.	L4

Course Content:

1. Preparation and staining of peripheral smear using Leishman's stain.

2. Identification of normal and abnormal morphology of red blood cells, white blood cells, and platelets.

3. Peripheral smear study, its correlation with clinical symptoms and comparison of peripheral smear results with complete blood count (CBC).

4. Reticulocyte count and its correlation with clinical symptoms

5. Demonstration of bone marrow aspiration and smear preparation.

6. Staining of bone marrow smears (Pearls 'Prussian blue stain) and its correlation with clinical symptoms

7. Preparation of iso-osmotic sucrose solution and performance of sucrose lysis test.

8. Identification of tests for hemoglobin variants and thalassemia. Explanation and interpretation of hemoglobin electrophoresis (e.g., sickle cell anaemia, thalassemia).

9. Sickling test. Performance and interpretation of the osmotic fragility test

10. Bleeding time, Clotting time, Prothrombin time (PT), Activated partial thromboplastin time (aPTT). Thrombin time, Platelet count, Fibrinogen count, and interpretation of first-line hemostasis tests. Blood collection procedures related to coagulation testing. Performance and interpretation of: Clot retraction, Inhibitor assays. Platelet function tests.

11. Identify the tests to detect hereditary haemolytic anaemia. Prepare reagents for the osmotic fragility test. Perform the osmotic fragility test and interpret the results. Integrate clinical symptoms and laboratory investigations to identify haematological disorders

Suggested Readings:

- Sood, R. (2009). *Medical Laboratory Technology, Vol-1 : Methods of Interpretation* (6th). India: Jaypee Brothers.
- Dacie, J. V. (2006). *Dacie and Lewis practical haematology*. Elsevier Health Sciences.
- McKenzie, S. B., Williams, J. L., & Landis-Piwowar, K. (2004). *Clinical laboratory hematology* (Vol. 1). Pearson education.
- Ramakrishnan, S., & Sulochana, K. N. (Eds.). (2012). *Manual of Medical laboratory techniques*. Jaypee Brothers Medical Publishers Pvt. Ltd.
- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*.

Basics of Pharmacology

Credit: 2= 30 hours

Course Rationale: Students will gain foundational knowledge in pharmacokinetics and pharmacodynamics, adverse drug effects, commonly used drugs in infectious and metabolic disorders, and the pharmacology relevant to laboratory diagnostics and interpretation.

Learning objective: At the end of the course, students should be able to

- Explain fundamental concepts of pharmacology
- Identify major classes of drugs, their therapeutic uses, mechanisms of action, and common side effects.
- Recognise signs and symptoms of common drug toxicities and the role of the laboratory in monitoring drug therapy.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom 's Level
CO1	Explain the basic principles of pharmacology including pharmacokinetics, pharmacodynamics, adverse drug reactions, and routes of drug administration.	L2
CO2	Describe the concepts of clinical trials, therapeutic drug monitoring, and essential drug parameters relevant to laboratory professionals.	L2
CO3	Identify the classification, mechanism of action, and resistance patterns of major antibacterial, antifungal, antiviral, antitubercular, and antileprotic drugs.	L1 & L2
CO4	Apply the principles of antibiotic sensitivity testing and laboratory monitoring of antimicrobial therapy in clinical practice.	L3
CO5	Illustrate the therapeutic uses and laboratory significance of drugs related to hormonal, metabolic, and endocrine disorders.	L2
CO6	Demonstrate the laboratory relevance of hematinics, anticoagulants, blood products, and drugs affecting hematological parameters in patient care.	L3

Course Content:

Unit	Topic	Hours
I	General Pharmacology: Branches of Pharmacology, Routes of Drug Administration, Pharmacokinetics (Absorption, Distribution, Metabolism, Excretion), Pharmacodynamics, Adverse Drug Reactions, Overview of Clinical Trials and Phases, Essential Drug Concepts for Laboratory Professionals (e.g., drug half-life, therapeutic drug monitoring)	8
II	Antimicrobial Chemotherapy: Classification of Antibacterial Drugs, Mechanism of Action and Resistance, Sulfonamides, Trimethoprim, Beta-lactams: Penicillin, Cephalosporins. Protein Synthesis Inhibitors: Aminoglycosides, Tetracyclines, Macrolides, Antitubercular and Antileprotic Drugs, Antifungals and Antivirals, Relevance of Antibiotic Sensitivity Testing, Laboratory Role in Monitoring Antimicrobial Therapy	12
III	Drugs Related to Hormonal and Metabolic Disorders: Insulin and Oral Hypoglycemic Agents, Thyroid and Antithyroid Drugs, Corticosteroids (overview and lab monitoring), Drugs affecting Calcium Balance, Antidiuretics, Relevance of Drug-induced Metabolic Changes in Lab Tests	6
IV	Drugs Acting on Blood and Blood-forming Organs: Hematinics and Use in Anaemia, Coagulants and Anticoagulants, Blood Products and Plasma Expanders, Overview of Anticoagulant Therapy and Its Relevance to Laboratory Monitoring (e.g., PT, INR, aPTT), Effects of Drugs on Haematological Parameters	4
	Total hours	**30**

Suggested Reading

- K.D. Tripathi – Essentials of Medical Pharmacology, Jaypee
- Padmaja Udaykumar – Pharmacology for Nurses
- Satoskar et al. – Pharmacology and Pharmacotherapeutics
- Relevant Laboratory Manuals/Drug Interaction Charts for Lab Technicians

SEMESTER-IV

Virology and Immunology

Credit =4 (60 hours)

Course Rationale: Students will understand the morphology and general features of viruses and gain comprehensive knowledge of the immune system, immune response, and diagnostic immunological techniques.

Learning Outcome: At the end of the course, students will be able to

- Identify clinically significant viruses that cause human disease and understand immunology
- Describe the pathogenesis, clinical features, and modes of transmission of common infectious diseases.
- Demonstrate proper techniques for specimen collection, handling, and processing in a clinical laboratory.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the history, taxonomy, replication, growth cycle, and pathogenesis of medically important viruses.	L2
CO2	Describe methods of cultivation, viral assay, viral genetics, and laboratory diagnosis of viral infections.	L2
CO3	Identify the morphology, transmission, clinical features, laboratory diagnosis, and prevention of major human viral diseases including HIV, hepatitis, influenza, herpes, and arboviral infections.	L1 & L2
CO4	Apply safety precautions and antiviral principles in handling viral specimens and virology laboratory procedures.	L3
CO5	Illustrate the structure and functions of the immune system, immune responses, antigens, antibodies, cytokines, complement system, and hypersensitivity reactions.	L2
CO6	Describe autoimmune disorders, immunodeficiency diseases, and principles of immunisation, vaccination, and national immunisation programmes in India.	L2

Course Content:

Unit	Topic	Hours
I	Introduction to virology: History of viruses, Viral taxonomy, Virus replication, Viral pathogenesis, Viral factors, Viral Growth Curve, Viral Growth Cycle. Host response, Environmental factors	5
II	Cultivation of Viruses, Detection of Virus Growth in Cell Culture, Different methods of cultivation of viruses, animal inoculations, egg inoculation, cell culture, Viral Assay, Viral Genetics, Classification of Viruses	5
III	Laboratory Diagnosis of Viral Infections:(1) direct detection of viruses/viral antigens, (2) demonstration of virus-induced cytopathic effects (CPEs) in the cells, (3) virus isolation, (4) viral assays, (5) detection of viral proteins and other enzymes, (6) detection of the viral genome and (7) viral serology	7
IV	Classify medically important viruses, Morphology, cultural characteristics, pathogenesis, lab diagnosis and treatment of Herpes virus, Poxviruses, Rhabdovirus, Orthomyxoviruses, Paramyxoviruses, Polio virus, Hepatitis virus, HIV, Oncogenic viruses, Arboviruses	15
IV	Prevention and Precautions in Virology: Safety precautions in the virology laboratory, Antiviral drugs	3
V	Immunology: The Immune Response, Innate immunity, adaptive immunity, acquired immunity- active and passive immunity	3
VI	Immune system: components of the immune system, immune cells and their functions, organs of the immune system - primary and secondary immune organs	3
VII	**Antigen and antibody:** Types of antigens and determinants of antigenicity, Structure and functions of different immunoglobulins, Properties and functions of antibodies- monoclonal and polyclonal antibodies. **Antigen-Antibody reactions**- Definition, Classification, General features, and mechanisms, applications of various antigen-antibody reactions **Immune response:** Classify immune response- Primary &Secondary Basic concept of humoral and cell-mediated immunity, Cytokines- define, classify, properties and functions **Complement system:** definition, components and activation pathways. Hypersensitivity- definition, types of hypersensitivity reactions	5 3 5

VIII	Autoimmune diseases: Primary and secondary immune deficiency disorders. Autoimmunity: Basic concepts of autoimmunity, risk factors and mechanisms of autoimmunity	4
IX	Immunisation/Vaccination: Active and passive immunisation, classification of vaccines, and immunisation schedule in India. Brief knowledge about the extended programme of immunisation (EPI) in India	2
	Total	**60**

Virology & Immunology Practical: **Credit : 2 = 60 hours**

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom 's Level
CO1	Demonstrate collection, transport, and processing of clinical specimens for virological investigations.	L3
CO2	Apply staining, cultivation, and identification techniques for diagnosis of viral infections using cell culture and egg inoculation methods.	L3
CO3	Perform immunological and serological techniques including ELISA, immunodiffusion, immunofluorescence, and Western blotting for diagnostic applications.	L3
CO4	Develop interpretation, biosafety, and quality control practices in virology and immunology laboratory investigations.	L4

Course Rationale: Students will demonstrate and perform diagnostic tests for viral infections and immunological disorders using serological and molecular techniques.

1. Collection, transport and processing of various clinical specimens for Virology

2. Identify the tests used for the diagnosis of viral infections

3. Integrate knowledge in the diagnosis of given clinical cases

4. Identify viruses and their replication using charts.

5. Perform Staining- Giemsa stain, Seller's stain, immunofluorescent staining procedures for the diagnosis of viral infections.

6. Demonstrate various inoculation routes in a fertilised hen egg

7. Perform serological tests, i.e. Widal, Brucella Tube Agglutination, VDRL (including Antigen Preparation), ASO Anti-Streptolysin O, C-Reactive Protein (Latex agglutination), Rheumatoid factor (RF) Latex agglutination, Rose Waaler test, RPR

8. Demonstrate ELISA, immunodiffusion, immunofluorescence, and Western blotting.

Suggested Reading

- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- Apurba Sankar Sastry & Sandhya Bhat K – *Essentials in Medical Microbiology*, Jaypee Brothers Medical Publishers
- Surinder Kumar – *Essentials of Microbiology*, Jaypee Brothers Medical Publishers
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- Fields Virology – Editors: David M. Knipe & Peter M. Howley, Published by Lippincott Williams & Wilkins
- P. Daniel Fudenberg, H. Hugh Fudenberg & John Stites – *Basic & Clinical Immunology*, Lange Medical Books
- Kuby Immunology – Authors: Jenni Punt, Sharon Stranford, Patricia Jones & Judy Owen, Published by W.H. Freeman
- S.K. Gupta – *Essentials of Immunology*, Jaypee Brothers Medical Publishers

Genetics and Molecular Biology

Credit =4 (60 hours)

Course Rationale: Students will learn the fundamentals of Genetics and molecular biology in order to understand the molecular basis of disease, perform and interpret basic molecular diagnostic tests.

Learning Outcome: At the end of the course, students will be able to

- Explain how genetic information is copied, transferred, and used in cells
- Describe how genes are inherited and how traits are passed through generations.
- Identify common laboratory techniques used to study genes

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the principles of Mendelian, non-Mendelian, polygenic, and sex- linked inheritance in human genetics.	L2
CO2	Describe chromosome structure, chromosomal aberrations, karyotyping, and their genetic consequences.	L2
CO3	Illustrate the stages and significance of mitosis, meiosis, chromosome segregation, and fertilization.	L2
CO4	Explain the structure, replication, and mutation of DNA and RNA involved in molecular inheritance.	L2
CO5	Apply the principles of gene expression, genetic code, transcription, and translation in molecular biology.	L3
CO6	Demonstrate the principles and applications of molecular diagnostic techniques including PCR, electrophoresis, chromatography, centrifugation, microscopy, sequencing, blotting, and microarray methods.	L3

Course Content:

Unit	Topic	Hours
I	**Introduction to Genetics:** Mendelian genetics –Principle of dominance, Principle of segregation, Principle of Independent Assortment, Genotype & phenotype; homozygous & heterozygous; dominant& recessive; gene & allele, Trait Inheritance – ABO blood groups in human; Polygenic Inheritance –Kernel colour in Maize, skin colour in man, Sex-linked Inheritance – haemophilia and colour blindness in man, Non- Mendelian Inheritance-Maternal inheritance	8
II	**Chromosomal basis of Inheritance:** Chromosome morphology- size and shape; Euchromatin and Heterochromatin- constitutive and facultative heterochromatin Chromosomes: Packaging of DNA in to Chromosomes, structure (centromere and telomere), karyotype, Structural chromosomal aberrations - duplications, deletions, inversions & translocations with examples, Genetic consequences, Numerical chromosomal aberrations– aneuploidy, euploidy auto-polyploidy and allo- polyploidy, Genetic consequences	12
III	**Cell division and chromosome segregation:** Mitosis – Stages in mitotic cell division- significance of mitosis. Meiosis – Formation of Synaptonemal complex, crossing over, chiasma formation, significance of meiosis. stages of mitosis, meiosis I&II& fertilization	6
IV	**Molecular basis of Inheritance** Structure of DNA and RNA, DNA replication, Mutations: types of mutations- transition, transversion, frame shift, silent, missense and nonsense	10
V	**Gene expression and regulation** Structure of eukaryotic gene, Transcriptional machinery in eukaryotes (RNA polymerases) and their structural and functional features; Genetic code, Transcription, translation	12
VI	**Molecular Diagnostics** ● Spectroscopy – principle, instrumentation, ultraviolet and visible light spectroscopy, and its applications ● Chromatography– types of chromatographic techniques (paper, ion exchange, chromatography, size exclusion chromatography)- principle & applications ● Centrifugation–principle and applications ● Electrophoretic techniques- types (Agarose gel electrophoresis, SDS PAGE), principle & applications ● Microscopy- principle & applications of Phase contrast microscope and bright field and fluorescence microscopy	12

	• PCR - principles and applications • Quantitative Real Time PCR– principle and applications. • DNA Sequencing – principle and applications. • Microarray- DNA and protein arrays - principle and applications. • Blotting techniques- Southern blot, Northern blot and Western blot- principle and applications. • Fluorescence & Chemiluminescence Imaging- principle and applications	
	Total	60

Genetics &Molecular biology Practical **Credit: 2 = 60 hours Course**

Course Outcomes

CO No.	Course Learning Outcomes	Bloom' s Level
CO1	Demonstrate extraction and quantitative estimation of DNA, RNA, and proteins using standard molecular laboratory techniques.	L3
CO2	Apply agarose gel electrophoresis and spectrophotometric methods for separation and analysis of nucleic acids.	L3
CO3	Perform biochemical assays including DPA, orcinol, and BSA methods for estimation of biomolecules.	L3
CO4	Develop interpretation skills for Western blotting, karyotyping, and identification of chromosomal abnormalities in genetic disorders.	L4

Rationale: Students will demonstrate and perform diagnostic tests widely used in molecular biology labs

1. Extraction of genomic DNA

2. Quantification of DNA by spectrophotometer

3. Agarose gel electrophoresis of DNA

4. Estimation of DNA by DPA method

5. Estimation of RNA by orcinol method

6. Estimation of Protein by BSA method

7. Western blotting

8. Karyotyping (normal male/normal female)

9. Identification of chromosome anomalies using Idiograms– Autosomal disorders (Down Syndrome / Edward's syndrome, Klienefelter's syndrome / Turner's syndrome)

Suggested Reading

- Molecular Cell Biology 6th edition (2007) Harvey F Lodish
- Techniques for molecular biology, D.Tagu C. Moussard, CRC Press
- Molecular diagnostics: for the clinical laboratorian by William B. Coleman and Gregory J. Tsongalis. Publisher: Humana Press

Clinical Pathology

Credit:4 (60 hours)

Course Rationale: Students will understand the principles and procedures for analysing urine, faeces, semen, sputum, and body fluids. They will learn to differentiate normal from abnormal findings and apply analytical techniques in clinical diagnosis.

Learning objective: At the end of the course, students should be able to

- Comprehend knowledge of formation, composition and function of body fluids
- Demonstrate proper technique for specimen collection, handling, and processing in a clinical Pathology laboratory.
- Apply standard laboratory techniques for the identification of the aetiology of infection.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the formation, composition, collection, preservation, and examination methods of urine in clinical pathology.	L2
CO2	Demonstrate physical, chemical, and microscopic examination of urine and identify abnormal urinary constituents in clinical conditions.	L3
CO3	Describe specimen collection, preservation, and laboratory examination methods for faecal and sputum analysis.	L2
CO4	Apply physical, chemical, and microscopic techniques for stool examination, occult blood testing, and identification of intestinal parasites.	L3
CO5	Illustrate the principles and clinical significance of semen analysis and examination of body fluids including CSF, pleural, peritoneal, synovial, and pericardial fluids.	L2
CO6	Demonstrate the use of special stains, automation, and advanced diagnostic techniques in clinical pathology laboratory investigations.	L3

Course Content:

Unit	Topic	Hours
I	**Urine analysis:** Formation and Normal Composition of urine, Indication of urine analysis, collection of urine, preservatives used for urine sample, examination of urine – Manual methods, dipstick method, urine analysers • Physical examination of urine and interpret the result - Volume, colour, odour, specific gravity, pH, turbidity • Chemical examination of urine and interpret the result for - Glucose - Protein - Blood - Ketones - Bile salt - Bile pigment • Examination for hemosiderin, chyluria, fat globules, and myoglobin detection in urine • Microscopic examination of urine- cells, casts, crystals, organisms, others • Characteristics of a normal and abnormal urine sample. List advanced techniques used in the field of diagnosis, Sources of errors, and Clinical conditions using laboratory results of urine analysis	12
II	**Faecal analysis:** Formation and Normal composition of stool, specimen collection, scotch tape preparation, Preservatives of stool specimen, Physical, chemical and microscopic faecal analysis • Physical examination-Volume, colour, consistency, odour, Blood, Mucus and Adult parasites • Test for occult blood • Saline and Iodine wet preparation, Concentration method, floatation method, and methylene blue stain	10
III	**Semen analysis:** Formation of semen, method of collection**,** importance and method of semen analysis-Normal and abnormal morphology of sperms Physical and chemical characteristics, sperm count, and Medico-legal aspects of specimen analysis	8
IV	Sputum Analysis: Formation of Sputum, Collection of Sputum, Analysis of Sputum	6
V	**Body fluids:** Different body fluids and methods of aspiration, characteristics of normal and abnormal body fluids, physical, chemical, and microscopic analysis of body fluids, procedure of cell count, clinical conditions - CSF, peritoneal, pericardial, pleural and synovial fluid **Other body fluids:** Function, volume and chemical composition, specimen collection, handling of amniotic fluid, examination of	15

	amniotic fluid, special tests performed in amniotic fluid Examination of bronchoalveolar Lavage, saliva, sweat, and tears.	
VI	Recent advances in clinical pathology that have led to the use of special stains in clinical pathology, and outline sample processing using automation in clinical pathology	4
	Total	**60**

Clinical Pathology Practical Credit: 2 (60 hours)

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom 's Level
CO1	Demonstrate collection, preservation, and processing of urine, stool, semen, sputum, CSF, and other body fluid specimens for clinical pathology investigations.	L3
CO2	Apply physical, chemical, and microscopic examination techniques for analysis of urine and stool specimens including special tests.	L3
CO3	Perform semen, sputum, CSF, and body fluid analysis and interpret laboratory findings in clinical conditions.	L3
CO4	Develop skills in automation, laboratory reporting, and quality control practices in clinical pathology investigations.	L4

Course Rationale: Students will demonstrate and perform physical, chemical, and microscopic examinations of clinical specimens using manual and automated methods.

Preanalytical: Proper method of sample identification for inpatients and Outpatients, Sample transport and processing, Sample acceptance and rejection criteria

1. Identify and process clinical specimens (urine, stool, semen, sputum, CSF, pleural, peritoneal, synovial, pericardial fluids)

2. Perform physical, chemical, and microscopic analysis of urine and stool

3. Conduct special test in urine -hemoglobin & myoglobin, pregnancy test

4. Perform Stool analysis – Physical, Chemical and Microscopic Examination

5. Perform semen analysis- Physical, Chemical and Microscopic Examination

6. Perform Cerebrospinal Fluid (CSF) examination - Physical, Chemical, and Microscopic Examination

7. Perform Sputum Analysis- physical, chemical, and microscopic examination

8. Perform Pleural Fluid examination -physical, chemical, and microscopic examination

9. Perform Synovial fluid examination- physical, chemical, and microscopic examination

10. Perform Peritoneal Fluid examination- physical, chemical and microscopic examination

11. Perform Pericardial Fluid examination- physical, chemical, and microscopic examination

12. Operate the automation system used in Clinical pathology

Suggested Readings

- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.
- Sood, R. (2006). *Textbook of medical laboratory technology*. Jaypee Brothers Publishers.
- Mundt, L., & Shanahan, K. (2020). *Graff's textbook of urinalysis and body fluids*. Jones & Bartlett Learning.
- Strasinger, S. K., & Di Lorenzo, M. S. (2014). *Urinalysis and body fluids*. FA Davis.

Medical Laboratory Management and Quality Control

Credit: 2 (30 Hours)

Course Rationale: Students are introduced to medical laboratories, quality management, laboratory information management systems applied in diagnostic laboratories, laboratory automation and point of care testing

Learning Outcome: At the end of the course, students will be able to

- Explain the principles of effective laboratory organisation, administration, and workflow planning
- Demonstrate knowledge of quality assurance (QA) and quality control (QC) practices in laboratory settings.
- Understand laboratory accreditation standards and regulatory requirements

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the principles of quality management systems, laboratory errors, quality indicators, and phases of laboratory testing in clinical laboratories.	L2
CO2	Describe internal and external quality control methods, Levey-Jenning charts, Westgard rules, CAPA, and good laboratory practices in laboratory quality assurance.	L2
CO3	Illustrate the concepts of laboratory accreditation, certification, NABL, ISO standards, audit procedures, and inventory management in medical laboratories.	L2
CO4	Apply automation technologies, laboratory analyzers, POCT devices, and total laboratory automation systems in clinical laboratory workflow.	L3
CO5	Explain the principles, components, applications, and data management functions of Laboratory Information Systems (LIS) and Laboratory Information Management Systems (LIMS).	L2
CO6	Demonstrate sustainable laboratory practices including waste management, energy efficiency, water conservation, digitalisation, and financial awareness in clinical laboratories.	L3

Course Content:

Unit	Topic	Hours
I	Total quality management of clinical laboratories: Define a quality management system, the three phases of the laboratory testing process, laboratory error, and quality indicators. List the quality indicators in the preanalytical phase and the sources of errors in the preanalytical, analytical, and postanalytical phases. Define the Root Cause Analysis (RCA) process. Define corrective actions and preventive actions (CAPA), CAPA for the control and prevention of errors in the clinical laboratory. Classify quality control: Internal quality control method, formulating quality control charts, Levey- Jenning charts, and Interpretation of Westgard rules. Explain external quality control method, the proficiency testing method in the clinical laboratory, and illustrate good laboratory practice	6
II	Accreditation and certification of laboratories: Define accreditation, certification and accreditation bodies. Explain the National Accreditation Board for Testing and Calibration Laboratories (NABL) and the International Organisation for Standardisation (ISO). Summarise the benefits of accreditation. Audit in a Medical Laboratory - Introduction and Importance, Responsibility, Planning, Horizontal, Vertical and Test audit, Frequency of audit, Documentation, Procurement of equipment and Inventory Control	4
III	Automation in Laboratory Workflow: Definition, Automation in Preanalytical, Analytical, and Post-analytical Phases. Types of Analyzers: Continuous Flow, Discrete and Dry Chemistry Analyzers. Automation in Immunology, Microbiology, Histopathology, Haematology, Biochemistry, Clinical Pathology. Total Laboratory Automation (TLA)- Robotic Process Automation (RPA), Laboratory Information Management System (LIMS), AI & Machine Learning – Predictive diagnostics and image analysis, Point-of-Care Testing (POCT) – Portable diagnostic devices, Automated Storage and Retrieval Systems (ASRS) – Efficient sample archiving. Point-of-Care Testing (POCT): Definition, types, goal, advantages and disadvantages. Working Principles of POCT Devices – *Glucometer, Urine Dipstick, Lateral Flow Immunoassay (LFIA)* Explain Waived vs. Non-Waived Tests, Calibration and Validation, Essential for quality assurance, regulatory compliance, and patient safety.	12

IV	Introduction to Laboratory information system (LIS), Laboratory Information Management Systems (LIMS). Operations: sample management, Instrument and application integration, electronic data exchange. Languages of Informatics and LIS, LIMS, and Middleware. Document Control, Data Mining Methods, Security, LIS Validation, components and working of LIS, applications of LIS	4
V	Sustainability of Clinical Laboratories: Waste Management, Energy Efficiency, Water Conservation, Green Procurement, Digitalisation. Introduction and awareness of financial management in a clinical laboratory	4
	TOTAL	**30**

Suggested Readings:

- Mirnali Sant, *Textbook of Medical laboratory Technology*, CBS publishers
- Godkar PB, *Textbook of Medical laboratory Technology,* Bhalani publishing house
- Paszko Christine, Turner Elizabeth (2001*) Laboratory Information Management Systems* (2nd edition) CRC Press Inc
- Douglas Shawn (2023). *The Complete Guide to LIMS and Laboratory Informatics* (1st edition) LabLynx Press

SEMESTER-V

Mycology & Parasitology

Credit=4 (60 hours)

Course Rationale: Students will gain comprehensive knowledge of medically important fungi and parasites, including their classification, morphology, pathogenesis, and laboratory diagnosis.

Learning Outcome: At the end of the course, students will be able to

- Identify clinically significant fungi and parasites that cause human disease
- Describe the pathogenesis, clinical features, and modes of transmission of common infectious diseases.
- Demonstrate proper techniques for specimen collection, handling, and processing in a clinical laboratory.

Course Outcomes:

Co. No.	Course Learning Outcomes	Bloom's Level
CO1	Define and classify medically important fungi, mycoses, and arthropods, and explain their characteristic features, reproduction, transmission, and public health importance.	L1 & L2
CO2	Describe the morphology, pathogenesis, laboratory diagnosis, treatment, and prevention of superficial, subcutaneous, systemic, and opportunistic fungal infections.	L2
CO3	Explain mycotoxins, fungal laboratory contaminants, culture media, specimen processing, isolation techniques, antifungal susceptibility testing, and preservation methods used in mycology laboratories.	L2 & L3
CO4	Illustrate the morphology, life cycle, mode of infection, laboratory diagnosis, treatment, and prevention of medically important protozoal parasites and vector-borne diseases in clinical context.	L2 & L3
CO5	Describe the geographical distribution, morphology, life cycle, laboratory diagnosis, treatment, and prevention of helminthic parasites including cestodes, trematodes, and nematodes.	L2
CO6	Apply laboratory methods for collection, preparation, staining, microscopic examination, serological testing, and identification of parasitic infections in various clinical specimens.	L3, L4 & L5

Course Content:

Unit	Topic	Hours
I	Introduction to Mycology: Taxonomy and classification of various medically important fungi, Characteristic features of fungi, reproductive methods of fungi, Normal fungal flora. Classification of mycoses.	4

II	Superficial mycoses- general characteristics of superficial mycoses Morphology, pathogenesis, laboratory diagnosis, and treatment of Piedra, Malassezia, Dermatophytoses, and Subcutaneous mycoses are the general characteristics of subcutaneous mycoses. Morphology, cultural characteristics, pathogenesis and lab diagnosis and treatment of Mycotic mycetoma, Sporotrichosis, Chromoblastomycoses,Subcutaneous phycomycosis, Rhinosporidiosis, Lobomycosis Systemic Mycoses -general characteristics of opportunistic systemic mycoses- Histoplasmosis, Blastomycosis, Coccidioidomycosis, Paracoccidioidomycosis General characteristics of opportunistic systemic mycoses- Morphology, cultural characteristics, pathogenesis and lab diagnosis and treatment of Candidiasis, Cryptococcosis, Aspergillosis, Penicillosis, Mucormycosis	15
III	Mycotoxicosis: Definition of Mycotoxin, Mycetismus, Method of Mycotoxins, preventive measures and treatment.	4
IV	Common fungal laboratory contaminants, Culture media used in mycology, Direct microscopy examination of fungi, Processing of clinical samples for diagnosis of fungal infections i.e. Skin, nail, hair, pus, sputum, CSF and other body fluids, Techniques used for isolation and identification of medically important fungi, Antifungal susceptibility tests, preservation of fungal cultures, Routine myco- serological tests and skin tests	7
V	Introduction of arthropods: Define and classify the arthropods of importance in public health. The sources and modes of transmission of infections are contaminated soil and water, foods, and vectors. Role of arthropods in the transmission of diseases Insects of medical importance: Morphology, life cycle, disease transmitted and control of Mosquitoes, Tse-tse fly, Fleas, Ticks, Housefly, Sand fly, Types of animal association- parasitism, commensalism, symbiosis	4
VI	Protozoology/ Protozoal parasites: General characteristics of protozoa. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection, laboratory diagnosis, treatment and prevention of • Amoebae (Entamoeba histolytica, non-pathogenic amoebae), • Flagellates (Trichomonas, Giardia lamblia, Trypanosoma, Leishmania), • Sporozoa (Plasmodium species, Toxoplasma species)	6

VII	Helminthology/ Helminthic parasites: Platyhelminthes: General characters of Platyhelminths. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection, laboratory diagnosis, treatment and prevention of Cestodes (Diphyllobothrium, Taenia, Echinococcus, Hymenolepis) - Trematodes (Schistosoma, Fasciola, Fasciolopsis, Clonorchis and Paragonimus)	7
VIII	Nemathelminthes: General characters of Nemathelminthes, Geographical distribution, Habitat, Morphology, life cycle, Mode of infection, laboratory diagnosis, treatment and prevention of Nematodes (Ascaris lumbricoides, Ancylostoma duodenale, Strongyloides stercoralis, Trichinella spiralis, Enterobius vermicularis, Trichuris trichura, Wuchereria bancrofti and Dracunculus medinensis)	8
IX	Laboratory diagnosis of parasitic diseases: Collection, preparation of specimens for the diagnosis of parasitic infection- Stool, Blood, Urine, sputum, Cerebrospinal fluid (CSF), Tissue and aspirates, Genital specimens Examination of Stool for parasites - intestinal protozoal infections, Macroscopic and microscopic examination of stool samples, Staining methods, i.e. Iodine staining and permanent staining, Concentration methods- Principles and applications, Chemical examination of stool, Occult blood, Bile pigment Examination of blood for parasites- Staining, examination of thin and thick blood film Immunology and Serology Tests- Skin Test, Animal Xenodiagnosis, Inoculation, Imaging and Haematology	5
	Total	**60**

Mycology & Parasitology Practical Credit: 2 = 60 hours

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate collection, transport, processing of clinical specimens, and preparation of culture media, reagents, and stains for mycological investigations.	L3
CO2	Apply microscopic and staining techniques including KOH preparation, Calcofluor White method, India Ink, Modified Kinyoun Acid-Fast stain, and Lactophenol Cotton Blue for fungal	L3

	identification.	
CO3	Perform identification of pathogenic fungi, intestinal parasites, adult worms, ova, and hemoparasites using standard laboratory procedures.	L3
CO4	Analyze stool examination, concentration methods, blood smear findings, and fungal culture characteristics for laboratory diagnosis of mycotic and parasitic infections.	L4

Course Rationale: Students would be able to identify various fungal strains and parasites. Students will also be correlated with the diseases associated with them.

1. Collection, transport and processing of various clinical specimens for fungal culture - Skin, nail, hair, pus, sputum, CSF and other body fluids and secretions

2. Prepare culture media, reagents and stains used for fungal analysis

3. Perform KOH preparation, Gram stain, Potassium Hydroxide - Calcofluor White method, India Ink preparation, Modified Kinyoun Acid Fast Stain for Nocardia, Lactophenol Cotton Blue preparation

4. Identification of pathogenic fungi - yeast, moulds, dimorphism in fungi

5. Perform stool examination for the detection of intestinal parasites with concentration methods- sedimentation and floatation methods

6. Identify adult worms, ova, and hemoparasites from slides or models

7. Examination of blood smears for hemoparasites**.**

Suggested Reading

- Jagdish Chander – *Textbook of Medical Mycology*, Jaypee Brothers Medical Publishers
- George S. Fischer – *Fundamentals of Diagnostic Mycology*
- C.K. Jayaram Paniker, *Paniker's Textbook of Medical Parasitology*, Jaypee Brothers Medical Publishers
- D.R. Arora & B. Arora – *Medical Parasitology*, CBS Publishers & Distributors
- P. Chakraborty – *Textbook of Medical Parasitology*, New Central Book Agency
- Lynne Shore Garcia – *Diagnostic Medical Parasitology*, ASM Press
- K.D. Chatterjee – *Parasitology in Relation to Clinical Medicine*, CBS Publishers & Distributors
- J.G. Collee, A.G. Fraser, B.P. Marmion, A. Simmons – *Mackie & McCartney Practical Medical Microbiology*, Elsevier
- Praful B. Godkar – *Textbook of Medical Microbiology and Parasitology*, Bhalani Publishing House
- K. Park – *Park's Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publishers

Immunohematology and Transfusion Medicine

Credit:4 = 60 hours

Course Rationale: Students will learn about blood grouping and blood transfusion. The students will learn about the concept of blood grouping, compatibility testing in blood transfusion, and screening of donated blood for various infectious diseases.

Learning Objective: At the end of the course, students will be able to

- Understand the principles of immunohematology, including blood group systems and their clinical significance
- Demonstrate knowledge of donor selection, blood collection, processing, storage, and component preparation.
- Perform routine blood grouping, cross-matching, antibody screening, and compatibility testing using standard laboratory techniques.
- Apply safety and quality control procedures in all aspects of blood banking and transfusion services.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Describe the history of blood transfusion, blood donor selection criteria, donor preparation, autologous transfusion, hemapheresis procedures, and management of donor adverse reactions.	L1 & L2
CO2	Explain the genetics, inheritance, variants, and clinical significance of ABO and Rh blood group systems including Bombay phenotype, weak D, Rh null, and Rh mod.	L2
CO3	Illustrate the preparation, storage, indications, dosage, and quality control of blood components including red cell products, platelets, plasma, and cryoprecipitate.	L2 & L3
CO4	Apply pretransfusion testing, compatibility testing, cross-matching techniques, and enzyme methods used in blood transfusion practices.	L3
CO5	Analyze transfusion reactions, transfusion-transmitted diseases, hemolytic disease of the newborn, and their laboratory investigations in clinical settings.	L4
CO6	Evaluate histocompatibility testing, HLA applications, biosafety measures, quality management systems, and regulatory standards followed in transfusion medicine services.	L4 & L5

Course Content

Unit	Topic	Hours
I	History of transfusion, Types of blood bags and their advantages and disadvantages, Blood donor selection criteria and donor preparation for collection, Autologous transfusion: Types of autologous blood collection, Hemapheresis: pertaining to Leucocytes, platelets and plasma, Donor adverse reaction and its management	**10**
II	History and discovery of various blood group systems, Genetics and inheritance of the ABO blood group system, Weak variants of the ABO blood groups, Bombay phenotype, Other phenotypes. Rh blood group system, weak D, Rh null, Rh mod	**10**
III	Components of blood for transfusion- Packed red cells, washed red cells, frozen Red cells, platelet-rich plasma (PRP), Platelet concentrate and frozen platelets. Fresh plasma (FP), Fresh Frozen Plasma (FFP) and cryoprecipitate, process of component preparation, storage, indications, transfusion dosage, and quality control	**12**
IV	Transfusion reactions- causes, clinical features, management and laboratory investigation, Pretransfusion tests and their clinical significance. Compatibility test in blood transfusion: Collection of blood for cross-matching from a blood bag, Major cross-matching, Minor cross-matching, use of enzymes in the blood bank, especially Papain	**12**
V	Transfusion-transmitted diseases and their laboratory investigations. Hemolytic disease of the newborn (HDN) and its investigations	**6**
VI	HLA Human Leucocytic antigen, Introduction to basic concepts of HLA and clinical applications of HLA testing, Techniques and principles of histocompatibility testing	**5**
VII	Regulatory agency that governs activities in the blood bank, Total quality management in transfusion service, including premises, personnel, instruments and reagents, Biosafety, external/internal quality control in Transfusion Medicine	**5**
	Total	**60**

Immunohematology and Transfusion Medicine practical **Credit: 2 = 60 hours**

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate preparation of pooled cells, cell suspensions, sensitized cells, and cell washing techniques used in immunohaematology laboratories.	L3
CO2	Apply ABO and Rh blood grouping, Du determination, and antibody screening procedures for blood group identification and compatibility assessment.	L3
CO3	Perform donor screening, blood collection, blood preservation, and blood component preparation according to standard transfusion medicine practices.	L3
CO4	Analyze cross-matching results and Coombs test findings for evaluation of blood compatibility and immunohematological disorders.	L4

Course Rationale: Students will gain practical knowledge in donor selection, phlebotomy, and managing donor reactions. They will be trained in pre-transfusion testing, investigating transfusion reactions, and diagnosing hemolytic disease of the fetus and newborn. The course also equips them with skills in blood collection, disease prevention, laboratory investigations, and interpretation of results.

1. Demonstrate the procedure for pooled cell preparation
2. Demonstrate the preparation of 5% cell suspension
3. Demonstrate the preparation of sensitised cells
4. Demonstrate the procedure for cell washing
5. Perform ABO and Rh grouping:
    a. Direct (preliminary) and indirect (proof) grouping.
    b. Rh grouping and Du determination.
6. Demonstrate Antibody screening:
    a. Forward (cell) grouping
    b. Reverse (serum) grouping
7. Donor Screening and Blood Collection
8. Preservation of blood for transfusion
9. Cross-matching: Major and minor cross-matching.
10. Coombs test: Direct and indirect Coombs test

11. Preparation of blood components

Suggested Reading

- Mamak, N., & Aytekin, İ. (2012). Principles of Blood Transfusion. *Blood Cell-An Overview of Studies in Hematology*.
- AABB. (2017). Technical manual (19th ed.). AABB.
- Sood, R. (2006). *Textbook of medical laboratory technology*. Jaypee Brothers Publishers.
- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house.
- Klein, H. G., & Anstee, D. J. (2013). *Mollison's blood transfusion in clinical medicine*. John Wiley & Sons.
- Harmening, D. M. (2018). *Modern blood banking & transfusion practices*. FA Davis.

Analytical Biochemistry

Credit=4 (60 hours)

Course Rationale: Students will gain knowledge on the principles and uses of analytical instruments such as photometry, chromatography, electrophoresis and automation used in Clinical laboratories or Research labs

Learning Objectives: At the end of the course, students will be able to

- Understand the principles and applications of common analytical techniques used in biochemistry.
- Demonstrate the ability to prepare samples and use laboratory instruments accurately for biochemical analysis.
- Apply quantitative and qualitative techniques to analyse biomolecules such as proteins, nucleic acids, carbohydrates, and lipids.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the principles, instrumentation, and clinical applications of photometry techniques including colorimetry, spectrophotometry, fluorimetry, flame photometry, and atomic absorption spectroscopy.	L2
CO2	Describe the principles, types, components, safety measures, maintenance, and laboratory applications of centrifugation techniques and instruments.	L1 & L2
CO3	Illustrate the principles, types, instrumentation, and diagnostic applications of chromatographic techniques including paper chromatography, TLC, ion exchange, affinity, gas chromatography, and HPLC.	L2 & L3
CO4	Apply the principles and laboratory applications of electrophoretic techniques for separation and analysis of proteins, lipoproteins, and isoenzymes in clinical specimens.	L3
CO5	Analyze the principles and clinical significance of osmometry, radioactivity, radioisotopes, radiation safety, and their applications in laboratory investigations.	L4
CO6	Evaluate the principles, methodology, and diagnostic utility of immunoassays and automation systems including ELISA, RIA, FIA, ECLIA, and automated chemistry analyzers used in clinical laboratories.	L4 & L5

Course Content:

Unit	Topic	Hours
I	**Photometry:** Theory of colorimetry, Beer-Lambert's law, Principles and applications of colorimetry, spectrophotometry, atomic absorption Spectroscopy, Fluorimetry and flame photometry in clinical laboratory	10
II	**Centrifugation:** Basic principles and units of centrifugation, Types of centrifugation and centrifuges, Rotors and tubes, Safety and maintenance, Applications of centrifugation in the laboratory.	4
III	**Chromatography:** Principles, types, Components and applications of Chromatography – Paper Chromatography, TLC, Ion Exchange, Affinity Gel Filtration, Gas Chromatography and HPLC in the laboratory.	10
IV	**Electrophoresis:** Principles, Types and applications – Agarose gel, Cellulose acetate and PAGE, and capillary electrophoresis. Electrophoresis of serum and urine protein, lipoprotein and isoenzymes	10
V	**Osmometry:** Principle and role of osmometry in clinical laboratory	6
VI	**Radioactivity:** Introduction, properties of alpha, beta and gamma radiations, radioisotopes, measurement of radioactivity, radiation hazards, radiation safety and precaution, Uses of radioisotopes.	6
VII	**Types of immunoassays and their principle:** Competitive and Non-competitive, immunometric assay and Turbidometry. RIA, ELISA, FIA and ECLIA	8
VIII	**Automation:** Principle of Automation, Semi-automated and fully automated chemistry analyser used in a clinical laboratory.	6
	Total	**60**

Analytical Biochemistry – Practical **Credit = 2 (60 hours)**

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate the operation of a semi-automated analyser for estimation of plasma glucose, serum protein, albumin, urea, uric acid, and creatinine.	L3
CO2	Apply analytical techniques including thin-layer chromatography, paper chromatography, and serum protein electrophoresis for biochemical investigations.	L3
CO3	Perform immunological and instrumental analytical methods such as ELISA, AAS, and HPLC for laboratory analysis of clinical samples.	L3

CO4	Analyze biochemical test results and chromatographic, electrophoretic, and immunological findings for accurate interpretation of laboratory data.	L4

Course Rationale:

Students will be equipped with various diagnostic tests and hands-on experience in a semi-automated analyser.

1. Estimation of biochemical parameters using a Semi-automatic analyser
    a. Plasma Glucose
    b. Serum protein
    c. Serum Albumin
    d. Serum Urea
    e. Serum Uric acid
    f. Serum Creatinine.
2. Demonstration of Analytical Techniques
    a. Thin-layer chromatography
    b. Serum protein electrophoresis
    c. ELISA
    d. AAS
    e. HPLC.
3. Paper chromatography and staining techniques.

Suggested Readings

- Wilson and walker's *Principles and techniques of biochemistry and molecular biology,* Cambridge university press.
- U. Sathyanarayana – *Biochemistry*, Elsevier
- Robert K. Murray et al. – *Harper's Illustrated Biochemistry*, Tata McGraw-Hill
- M.N. Chatterjee & Rana Shinde – *Textbook of Medical Biochemistry*, Jaypee
- Alan Gowenlock – *Varley's Practical Clinical Biochemistry*, CBS
- Textbook of Clinical Chemistry by Teitz

Medical Law and Ethics

Credit: 2=30 hours

Course Rationale: Students are formulated to impart the basic concept of medical ethics, guidelines about human ethics, and animal ethics. Students will also learn about the Indian legal system, medico-legal cases and essential acts.

Learning Objectives: At the end of the course, students will be able to

- Comprehend knowledge of medical and bioethics
- Follow good laboratory practice and appropriate ethical guidelines while conducting research on animal and human samples.
- Understand the Indian Legal system, medico legal records, human rights act, disaster management, Human Organ Transplantation Act, mental Health act, professional indemnity insurance policy and IPR

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom 's Level

Course Content:

Suggested reading:

- Bonnie F. Fremgen – *Medical Law and Ethics, Pearson Education*
- Jonathan Herring – *Medical Law and Ethics, Oxford University Press*
- ICMR – *Ethical Guidelines for Biomedical Research on Human Participants (2017)*
- John D. Angelo-*Ethics in Science (2012)*. *Ethical Misconduct in Scientific Research.* CRC Press, Taylor & Francis Group
- Hazel Biggs-*Healthcare Research Ethics and Law. Regulation, Review &Responsibility. (2010)*. Cavendish Biomedical Law & Ethics Library
- Graf, C. et al.- *Best practice guidelines on publication ethics: a publisher's perspective.* (2007). International journal of clinical practice, 61, 1-26
- Gluck et al. *Applied ethics in animal research: philosophy, regulation, and laboratory applications*, (2002) Purdue University Press

SEMESTER-VI

Applied Pathobiology

Credit=4(60 hours)

Course Rationale: This course provides an in-depth study of the cellular and tissue-level mechanisms that underlie disease processes. It covers key principles of cell injury, inflammation, healing, immune pathology, and neoplasia, with an emphasis on histopathological changes and their clinical implications.

Learning Objectives: By the end of this course, students will be able to :

- Understand the fundamental concepts of disease processes, including cell injury, inflammation, repair, and neoplasia
- Explain the mechanisms of cellular adaptation, degeneration, necrosis, apoptosis, and other pathological changes.
- Apply knowledge of general pathology to interpret basic histological findings and laboratory results relevant to common diseases.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the concepts of pathobiology, cellular adaptations, mechanisms of cell injury, necrosis, apoptosis, intracellular accumulations, and pathological calcification.	L1 & L2
CO2	Describe the mechanisms, mediators, types, and outcomes of inflammation, granuloma formation, tissue repair, regeneration, fibrosis, and wound healing.	L2
CO3	Illustrate the pathology, clinical features, and laboratory relevance of hemodynamic disorders, shock, hypersensitivity reactions, autoimmune disorders, diabetes, HIV, and tuberculosis.	L2 & L3
CO4	Differentiate benign and malignant neoplasms and explain carcinogenesis, tumour progression, tumour spread, grading, staging, and tumour markers used in laboratory diagnosis.	L3 & L4
CO5	Analyze the etiology, pathogenesis, clinical manifestations, and laboratory diagnosis of important infectious and parasitic diseases including anthrax, pertussis, candidiasis, amoebiasis, malaria, TORCH infections, hepatitis, and pulmonary tuberculosis.	L4
CO6	Evaluate pathological alterations and correlate laboratory findings with disease conditions for accurate interpretation in diagnostic pathology practice.	L4 & L5

Course Content:

Unit	Topic	Hours
I	Introduction to Pathobiology & Cell Injury: Definition and scope of pathology, Cellular adaptations: hypertrophy, hyperplasia, atrophy, metaplasia, Mechanisms of cell injury: physical, chemical, biological, Morphology of reversible and irreversible injury, Cell death: necrosis (types), apoptosis, Intracellular accumulations – Lipids, cholesterol, proteins, glycogen and pigments; examples, Pathologic calcification – Types and examples.	8
II	**Inflammation and Repair: Definition and symptoms,** Acute inflammation: signs, vascular and cellular events, Chemical mediators of inflammation, Chronic inflammation and granuloma formation, Healing: Regeneration and fibrosis, wound healing stages, factors affecting wound healing.	12
III	**Hemodynamic and Immune Disorders:** Edema, hyperemia, haemorrhage, thrombosis, embolism, infarction, Difference between transudate and exudate, Shock: types and pathology, Hypersensitivity reactions (I–IV), autoimmunity: examples (SLE, rheumatoid arthritis), Diabetes, HIV, Tuberculosis	12
IV	**Neoplasia:** Definitions and nomenclature of tumours, Differences between benign and malignant tumours, Histological features: anaplasia, differentiation, invasion, carcinogenesis: chemical, radiation, and viral, mode of tumour spread, Clinical aspects of neoplasia, grading and stages of tumour, Tumour markers and lab diagnosis (AFP, PSA, CEA, etc.)	16
V	**Infectious and Parasitic Diseases:** Anthrax, Whooping Cough (Pertussis), Candidiasis, Amoebiasis, Malaria, TORCH Complex, Hepatitis type laboratory diagnosis, Pulmonary tuberculosis and lab diagnosis	12
	Total	**60**

Applied Pathobiology Practical **Credit: 2 =60 hours**

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate handling, processing, and preservation of clinical and pathological specimens following standard laboratory safety protocols.	L3

CO2	Apply staining, microscopic examination, and laboratory techniques for identification of pathological alterations and infectious diseases.	L3
CO3	Analyze cellular changes, inflammatory conditions, neoplastic features, and laboratory findings for pathological interpretation.	L4
CO4	Evaluate diagnostic procedures, quality control practices, and laboratory reports for accurate disease diagnosis and clinical correlation.	L5

Course Rationale: The course will bridge the diagnostic foundation of disease mechanisms including anatomy, physiology, and microbiology. The course emphasizes the integration of clinical knowledge with laboratory practice, enabling students to understand how cellular and tissue changes reflect disease processes.

1. Basic interpretation of histopathological slides (normal vs diseased tissue)
2. Microscopic Identification of Cellular Changes: (i) Hypertrophy, (ii) atrophy (iii) dystrophy
3. Microscopic pattern recognition in (i) inflammation, (ii) neoplasia, (iii) necrosis
4. Identification of pathological features in gross specimens: (i) liver, (ii) lung, (iii) kidney, (iv) heart, and any other organs
5. Correlation with clinical symptoms and microscopic imaging of disease- case based studies
6. Reporting practice in histopathology and cytology (minimum 15-20 different case studies can be incorporated).

*** If the Institutes are having limitations with biological samples educational slides are readily available which can help them to learn the basic needs of the practical. The remaining hours can be compensated by clinical lab rotations

Suggested Reading:

- Mohan, H. (2015). Textbook of pathology. Jaypee Brothers Medical Publishers.
- Kumar, V., Abbas, A. and Aster, J. (2020) Robbins and Cotran Pathologic Basis of Diseases. 10th Edition, Elsevier
- MOHAN, Harsh. (2013). Pathology Practical Book. New Delhi: Jaypee Brothers Medical.
- Klatt, E. C. (2014). Robbins and Cotran atlas of pathology. Elsevier Health Sciences.
- Godkar, P. B., & Godkar, D. P. (2006). *Textbook of medical laboratory technology*. Bhalani publishing house

Cytology and Histopathology

Credit: 4 = 60 hours

Course Rationale: Students will develop a comprehensive understanding of the principles and practices in Cytology and Histopathology. Students will also learn about the organisation of laboratories, specimen collection and processing, cytological and histological techniques, routine and special staining methods, and the interpretation of cellular and tissue morphology.

Learning Objectives: At the end of the course, students will be able to

- Understand the principles and techniques involved in the preparation, fixation, processing, and staining of tissue and cytological specimens
- Demonstrate proper techniques for specimen collection, labelling, and handling to preserve diagnostic quality.
- Perform routine and special staining techniques used in histopathology and cytopathology.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the principles, organization, specimen handling, fixation, processing, mounting, and quality control procedures followed in cytology laboratories.	L1 & L2
CO2	Describe the sampling techniques, staining methods, and diagnostic applications of exfoliative cytology, aspiration cytology, sex chromatin studies, and fluid cytology.	L2
CO3	Illustrate the principles and laboratory applications of liquid-based cytology, molecular cytology, and cell block techniques in diagnostic practice.	L2 & L3
CO4	Apply histopathological procedures including tissue fixation, decalcification, processing, embedding, section cutting, frozen section preparation, and microtomy techniques in laboratory settings.	L3
CO5	Analyze routine and special staining techniques, immunohistochemistry procedures, staining artefacts, and their diagnostic significance in histopathology.	L4
CO6	Evaluate museum techniques, automated laboratory systems, quality assurance measures, and histopathological findings for accurate tissue diagnosis and laboratory management.	L4 & L5

Course Content:

Unit	Topic	Hours
I	Introduction to Cytology: Definition of cytology, organisation of cytology laboratory, Types of cytology, Cytological sampling techniques, Sample acceptance and rejection criteria, fixation, reception, processing, and mounting of cytological specimens, Quality control in cytology	5
II	Exfoliative Cytology: Cervical cytology, Fluid cytology-Urinary tract, Respiratory system, CSF, Body fluids. Sex chromatin demonstration and karyotyping, Vital staining for sex chromatin, Aspiration cytology, Cytology staining techniques- PAP, MGG, Shorr's stain, Aceto-orcein stain	10
III	Automation in Cytology: Liquid-based cytology: principles and preparation, Molecular cytology, Cell block technique	5
IV	Introduction to histopathology laboratory: Definition of biopsy and autopsy, Types of tissues received, Storage and documentation, Steps in tissue preparation, Grossing procedures, Handling tiny tissue specimens, Quality assurance	6
V	Fixatives: Definition and classification, Qualities of ideal fixatives, Common fixatives used, Methods of fixation, Methods for removing excess fixative	4
VI	Tissue processing: Definition and methods of decalcification, acid-containing decalcifying fluids, determination of endpoint of decalcification, steps in tissue processing - Dehydration, clearing, impregnation. Embedding moulds and media, Automated tissue processor: parts and working	5
VII	Section cutting: Definition and classification of microtomes, Care and maintenance of microtomes, Microtome knives and sharpening techniques, Automated knife sharpener, Disposable blades, Requirements and process of section cutting, Adhesives preparation, Causes and remedies for improper sections, Frozen section-Importance, Technique, Freezing microtome and cryostat	10

VIII	Routine staining technique: Theories of staining, Definitions: dye, mordents, alum. Classification of haematoxylin, H&E staining and rapid technique, Automated stainer, Mounting media: classification, preparation, purpose. Immunohistochemistry- Tissue preparation and staining, detection of artefacts and remedies	5
IX	Special stains in histopathology- Principle and use of staining procedure o Mucosubstances: PAS, Alcian Blue, Colloidal iron, High iron diamine, Mayer's Mucicarmine o Connective tissue: Vangieson, Masson's Trichrome o Reticulin fibres: Gomori's silver, Gordon and Sweets o Elastic fibres: Verhoff's stain o Pigments and minerals: Pearls Prussian blue o Microorganisms: AFB stain o Amyloid: Congo red o Lipids and fats: Oil Red O o Metachromatic staining: Toluidine blue (frozen section	7
X	Museum Techniques: Specimen mounting steps, fixation of specimens, Museum technique steps	3
	Total hours	**60**

Cytology and Histopathology Practical **Credit: 2 =60 hours**

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate collection, fixation, processing, embedding, and section cutting techniques for cytological and histopathological specimens.	L3
CO2	Apply routine and special staining procedures, cytological techniques, and immunohistochemistry methods in diagnostic laboratory practice.	L3
CO3	Analyze microscopic features, staining characteristics, and tissue morp hology for interpretation of pathological conditions.	L4
CO4	Evaluate quality assurance procedures, staining accuracy, artefacts, and laboratory safety practices in cytology and histopathology laboratories.	L5

Course Rationale: Students will gain practical knowledge of techniques used in Cytology and Histopathology laboratories, including specimen collection, preservation, and processing of various cytological samples. They will also learn to perform routine and special staining procedures and identify chromosomal abnormalities

1. Demonstrate receiving, handling, and labelling and specimen rejection criteria of cytological specimen.

2. Fine needle aspiration cytology

3. Preparation of fixatives in cytology laboratory and fixation of cytological specimens

4. Demonstrate cytological specimen preservation.

5. Demonstrate specimen processing in cytology – Gynaecological, Urine, Body fluids, Cerebrospinal fluid (CSF), sputum, - Liquid-based cytology.

6. Preparation for Papanicolaou (Pap) stain

7. Demonstrate staining - May-Grunwald Giemsa (MGG) staining, Myeloperoxidase staining, Sudan black B (SBB), Nonspecific esterase, Per Iodic acid Schiff staining (PAS), Neutrophil alkaline phosphatase (NAP), Gabbet's modified Ziehl Neelsen staining.

8. Quality control in a cytology laboratory

9. Demonstrate the preparation of fixatives- 10% Neutral buffered formalin, Formal Saline.

10. Demonstrate preparation of decalcifying fluid - Gooding & Stewart's fluid

11. Perform the tissue processing – fixation, dehydration, clearing, impregnation

12. Demonstrate the procedure for knife sharpening - Honing & stropping

13. Perform section cutting of tissue block using a microtome

14. Haematoxylin and Eosin staining

15. Perform mounting of the stained section

16. Demonstrate staining for carbohydrates, lipids, amyloid collagen, reticulin, elastic fibers, pigments, and Acid-Fast Bacillus (AFB).

17. Demonstrate immunohistochemistry techniques, Enzyme histochemistry diagnostic applications and the demonstration of phosphates, dehydrogenases, oxidases and peroxidases

Suggested Readings:

- Bancroft, J. D., & Gamble, M. (Eds.). (2008). *Theory and practice of histological techniques*. Elsevier health sciences.

- Koss, L. G., & Melamed, M. R. (Eds.). (2006). *Koss' diagnostic cytology and its histopathologic bases* (Vol. 1). Lippincott Williams & Wilkins.
- Ramakrishnan, S., & Sulochana, K. N. (Eds.). (2012). *Manual of Medical laboratory techniques*. Jaypee Brothers Medical Publishers Pvt. Ltd.
- Lynch, M. J., & Raphael, S. S. . Lynch's Medical laboratory technology.
- Baker, F. J., & Silverton, R. E. (2014). *Introduction to medical laboratory technology*. Butterworth-Heinemann.
- Koss, L.G. and Melamed, M.R. eds., 2006. *Koss' diagnostic cytology and its histopathologic bases* (Vol. 1). Lippincott Williams & Wilkins.
- Nayak, R., & Nayak, R. (2023). *Review of Postgraduate Pathology (Systemic Pathology): Two Volume Set*. JP Medical Ltd.
- Carson, F. L., & Cappellano, C. H. (2009). Histotechnology: A self-instructional text (3rd ed.). ASCP Press.
- Curran, R. C., & Crocker, J. (2000). Curran's atlas of histopathology. *(No Title)*.
- Sadhana Vishwakarma (2017). Edition : 1/e. **Techniques in Histopathology and Cytopathology**.
- Cibas, E. S., & Ducatman, B. S. (2003). *Cytology: Diagnostic principles and clinical correlates*. Gulf Professional Publishing.

Clinical Biochemistry

Credit =4 (60 hours)

Course Rationale: Students will understand organ function tests, disorders related to abnormalities, and lab techniques used to diagnose disorders

Learning Objectives: At the end of the course, students will be able to

- Explain the principles and clinical significance of biochemical tests used to assess organ function and disorders of metabolism
- Perform routine and specialised biochemical analyses on clinical specimens
- Demonstrate knowledge of automation, instrumentation, and data management in clinical biochemistry.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the principles of GCLP, laboratory safety, universal precautions, specimen collection, sample processing, and preanalytical quality measures in clinical biochemistry laboratories.	L1 & L2
CO2	Describe analytical and post-analytical laboratory procedures including SOPs, quality control, calibration, statistical tools, Westgard rules, report generation, and documentation practices.	L2
CO3	onitoring of diabetes mellitus and screening of inborn errors of metabolism in clinical practice.	L3
CO4	Illustrate the principles, indications, and clinical significance of liver, renal, gastric, pancreatic, and thyroid function tests used in diagnostic biochemistry.	L2 & L3
CO5	Analyze cardiac function tests, lipid profile, enzyme patterns in acute myocardial infarction, acid-base balance, and blood gas analysis for clinical interpretation.	L4
CO6	Evaluate the biochemical basis of cancer, carcinogenesis, tumour markers, and laboratory diagnostic approaches used in oncology investigations.	L4 & L5

Course Content:

Unit	Topic	Hours
I	**GCLP:** laboratory safety and Universal precaution, Introduction to Phases in Laboratory, Preanalytical - Specimen collection, processing and handling in clinical laboratory, Sample acceptance and rejection criteria, Sources of error.	3
II	**Analytical Phase:** SOP, Laboratory equipment- maintenance, lab reagents and kits, calibrators, concept of accuracy, precision, reliability, reproducibility, Quality control (IQC and EQA), Basic statistics (Mean, Median, SD, CV), Westgard rule, LJ graph, Types of error in analytical phase.	3
III	**Post Analytical Phase:** Report generation, Types of error in post analytical, storage and retention of sample, Documentation of report	3
IV	**Laboratory diagnosis of Diabetes mellitus** – Plasma glucose (Fasting, Random, Post Prandial, OGTT, glycosylated haemoglobin. **Screening test for inborn errors of metabolism-** PKU, Alkaptonuria, Fructosuria, galactosemia, hypercholesterolemia.	8
V	**Liver Function Test:** Indications and classification of LFT, Test based on bile pigment metabolism, classification of jaundice, Test- based serum enzymes	6
VI	**Renal Function Test:** Indications and classification of RFT. Test based on glomerular filtration, renal plasma flow, and tubular functions. Acid-base balance, including blood gas analysis	6
VII	**Gastric Function Test:** Indication and classification of GFT, Examination of resting content. **Pancreatic Function Test:** Indication of Pancreas function test- Lipases and Amylases	6
VIII	**Thyroid Function Test:** Indications and classification of thyroid function test, tests based on primary function, and blood levels of thyroid hormones.	4
IX	**Cardiac Function Test:** Indications of Cardiac function test, Cardiac markers, lipid profile, Enzyme pattern in AMI	5

X	**Biochemistry of cancer:** Properties of cancer cells, morphological and biochemical changes in cancer cells, carcinogenesis, carcinogens, diagnosis of cancer – oncogenic markers (AFP, PFA, CEA, bHCG, Myeloma -Bence Jones protein, M band)	4
	Total	**60**

Clinical Biochemistry-Practical **Credits = 2 (60 hours)**

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Demonstrate specimen collection, processing, handling, and operation of laboratory instruments following GCLP and biosafety guidelines.	L3
CO2	Apply biochemical techniques and analytical procedures for investigation of liver, renal, cardiac, thyroid, pancreatic, and metabolic disorders.	L3
CO3	Analyze biochemical parameters, quality control data, and laboratory findings for interpretation of clinical conditions.	L4
CO4	Evaluate analytical accuracy, laboratory reports, quality assurance measures, and diagnostic significance of biochemical investigations.	L5

Course Rationale: Students will be able to understand and critically diagnose various organ function tests and enzyme markers.

1. Construction of the Levey-Jennings (LJ) graph and interpretation of Westgard rule

2. Oral Glucose Tolerance Test (OGTT) Estimation of following profile test using the kit method

3. Lipid profile

    a. Triglycerides

    b. Cholesterol

    c. HDL

4. Renal Function Test

    a. Urea

    b. Uric acid

    c. Creatinine

5. Liver function test

a. Total Protein

b. Albumin

c. Total Bilirubin

d. Direct bilirubin

e. SGOT

f. SGPT

g. Alkaline Phosphatase

h. Urinary Bile salt, Bile pigment, urobilinogen

6. Electrolytes

a. Sodium

b. Potassium

c. Chloride

Demonstration of the following

7. Glycosylated Hemoglobin (HbA1C)

8. Thyroid Function Test

a. T3

b. T4

c. TSH

Suggested Reading

- U. Sathyanarayana – *Biochemistry*, Elsevier
- Robert K. Murray et al. – *Harper's Illustrated Biochemistry*, Tata McGraw-Hill
- M.N. Chatterjee & Rana Shinde – *Textbook of Medical Biochemistry*, Jaypee
- Alan Gowenlock – *Varley's Practical Clinical Biochemistry*, CBS
- Nader Rifai et al, *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics,* Saunders

Biostatistics and Research Methodology

Credit 2 =30 hours

Course Rationale: Students will understand statistical concepts and research methods applicable to laboratory sciences and be able to analyse and interpret data in clinical research.

Learning Objectives: At the end of the course, students will be able to

- Understand basic concepts of biostatistics, including types of data, measures of central tendency, and variability.
- Demonstrate knowledge of sampling techniques, study designs and data collection methods.
- Apply appropriate statistical methods to analyse and interpret health and biomedical data.

Course Outcomes:

CO No.	Course Learning Outcomes	Bloom's Level
CO1	Explain the concepts, scope, significance, types of data, levels of measurement, and methods of data organization and presentation used in biostatistics.	L1 & L2
CO2	Describe the principles and applications of descriptive statistics, measures of dispersion, probability, and normal distribution in healthcare research.	L2
CO3	Illustrate the need, methods, advantages, and errors associated with probability and non-probability sampling techniques in research	L2 & L3
CO4	Apply correlation, regression, scatter plots, and statistical methods for interpretation and prediction of biomedical data.	L3
CO5	Analyze hypotheses and perform statistical significance tests including Chi-square test, t-test, ANOVA, and Mann-Whitney U test using statistical software.	L4
CO6	Evaluate research designs, literature review methods, data collection techniques, and data sources for conducting scientific biomedical research.	L4 & L5

Course Content:

Unit	Topic	Hours
I	Introduction to biostatistics: Concepts, types, significance and scope of statistics, meaning of data, sample and parameter, Types and levels of data and their measurement, Organisation and presentation of data- tabulation of data, Frequency distribution, Graphical and tabular presentation	**3**

II	Descriptive statistics: Measures of dispersion- Range, Inter-quartile range, Variance, Standard deviation and Coefficient of variation	**6**
III	Introduction to probability and normal distribution. Normal distribution - characteristics of normal distribution	**3**
IV	Sampling methods: Need for sampling and the advantages of sampling over complete enumeration, Sampling and non-sampling error, Probability and nonprobability sampling methods	**3**
V	Measures of relationship: Correlation – need and meaning, Rank order correlation, Scatter plot, Simple linear regression and prediction	**4**
VI	Testing of significance: Hypothesis, Non-Parametric test- Chi-square, t-test, ANOVA, Mann-Whitney U test. Use of statistical software for data analysis	**6**
VII	Introduction to research methodology: Research methodology, research design and review of literature, Different methods of data collection and data sources	**5**
	Total	**30**

Suggested reading

- S.P. Gupta – *Statistical Methods*, Sultan Chand & Sons
- B.K. Mahajan – *Methods in Biostatistics for Medical Students*, Jaypee Brothers Medical Publishers
- Himanshu Tyagi – *RPG Biostatistics*, CBS Publishers & Distributors
- World Health Organisation (2001) – *Health Research Methodology: A Guide for Training in Research Methods*, WHO Press

Semester VII & VIII

Course Code	Category	Lectures(L) Hours per week	Tutorial (T) Hours per week	Practical (P) Hours per week	Total Credits
VII Sem	Core	-	-	42	20
VIII Sem	Core	-	-	42	20

Course Rationale: The internship provides a structured transition from theoretical understanding to practical competency in medical laboratory sciences. It supports the development of technical skills, ethical responsibility, and professional identity, preparing students to function independently and collaboratively in clinical laboratories and research settings.

By rotating through specialized disciplines, students deepen their understanding of diagnostic procedures, automation, specimen handling, and healthcare workflows. This experience fosters critical thinking, interdisciplinary collaboration, and readiness for national/global healthcare environments.

Internship Duration: 12 months (Semester VII & VIII)

Schedule: 42 hours/week (7 hours/day, 6 days/week)

Learning Outcome

- Preanalytical phase - Safely collect, identify, and manage clinical specimens, follow proper safety precautions
- Conduct clinical investigations and interpret findings
- Perform equipment quality control and resolve technical issues
- Manage documentation, communication, ethics, and teamwork
- Demonstrate leadership and entrepreneurship in lab environments
- Write and critique scientific literature reviews

Internship Rotation Structure & Competencies

Area	Duration (Months)	Competencies
Pathology	2	Sample processing, staining, cryostat handling, FNAC

Hematology & Clinical Pathology	2	Phlebotomy, smear reading, automation, urinalysis
Transfusion Medicine	2	Blood component preparation, donor monitoring, transfusion-transmitted disease screening
Clinical Biochemistry	2	Biochemical analysis, automated system, Quality control
Microbiology	2	Culturing, antimicrobial susceptibility testing, media preparation, QC strains
Research (Individual/group projects can be included)	2	Literature review, topic formulation, manuscript drafting

Internship Rotation Plan:

- **Posting Guidelines**: Each student completes all rotations with documented competent acquisition.
- **Attendance & Conduct**: Minimum 90% attendance and adherence to institutional guidelines required.
- **Assessment**: Non-CGPA contributing; qualitative evaluations are documented.
- **Certification**: Granted upon satisfactory completion, verified by HOD/Coordinator and HOI.

Competency Domains for Alignment

Domain	Representative Competencies
Cognitive & Technical	Clinical reasoning, diagnostic accuracy, QC protocols
Affective & Ethical	Professionalism, patient safety, lab ethics
Psychomotor	Skill-based performance, automation handling, specimen processing
Communication & Collaboration	Documentation, interdisciplinary teamwork
Research & Innovation	Literature review, evidence synthesis, scientific writing
Leadership & Entrepreneurship	Initiative, mentorship, resource management

Internship Logbooks

- **Daily Tracking**: Structured entries with dates, tasks, and supervisor validation
- **Weekly Goals**: Intern sets rotation-specific targets
- **Competency Checklist**: Per module, includes skill validation (e.g., staining, cryostat handling)
- **Supervisor Feedback**: 5-point scale on independence, safety, and professional behavior

Formative Assessment

- Objective Structured Practical Examination (OSPE)
- Mini Clinical Evaluation Exercise (Mini-CEX)
- Reflective Portfolios
- Supervisor Evaluations
- Peer-Reviewed Research Logs
- Recorded Demonstrations

Certification: Internship completion certificate includes:

- Clinical rotation postings and total hours
- Externship and research details
- Authenticated by HOD/Coordinator and HOI
- **Note**: Degree awarded only upon validated internship completion

Cover Page of Log book

MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

MAHATMA GANDHI INSTITUTE OF ALLIED HEALTH SCIENCES

INTRENSHIP LOG BOOK

B.MLS (VII/VIII

SEMESTER)

STUDENT'S RECORD

Name **:**……..….

Semester **:**……...

Enrollment No **:**……..….

Session **:**……...…….

……..….. ……..……..

Signature of Principal Signature of Student

DECLARATION BY THE STUDENT

Madam/Sir,

I, Mr/Ms..... a student of ……..….. bearing Registration No. …… declare that I have completed ……..... hours of Internship duty, out of the assigned …… hours and have performed my duties in the hospital/laboratory as stated in my logbook

Students Signature

MAHATMA GANDHI UNIVERSITY of MEDICAL SCIENCES & TECHNOLOGY JAIPUR

MAHATMA GANDHI INSTITUTE OF ALLIED HEALTH SCIENCES

LOGBOOK CERTIFICATE

This is to certify that the candidate Mr/Ms …… registration number…… admitted in the academic year of ……college, has satisfactorily completed/ Not completed all requirements mentioned in this logbook for seventh/ eighth semester of Bachelor of Medical Laboratory Sciences during the period from ……to …….. in the…….. Hospital/Laboratory.

Signature of the Faculty in-Charge (hospital/laboratory)

Name

Date

Signature of the Principal/Dean HoD (University/College)

Name

Date

SKILL ASSESSMENT SHEET

Hospital/Laboratory: **Department:**

Date	Name of Experiment	Observed / Assisted/ Performed	Signature of supervisor/In- charge

Model Paper

B.MLS Semester-I
Code: BMLS101

Bachelor of Medical Laboratory Science
Semester I
Human Anatomy
Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

(a) Define the chambers, valves, and blood supply of the heart. (CO5, L1)

(b) Classify the structure, classification, and functional aspects of joints. (CO3, L1)

(c) Describe the structure of the kidney and urinary system. (CO4, L2)

Q.2. Short Essay Questions (Attempt any 7) 7 × 5 = 35 Marks

(a) Anatomical planes and their significance. (CO1, L1, L2)

(b) Classify epithelial tissue with examples. (CO2, L2)

(c) Structure of lungs and pleura. (CO4, L2)

(d) Structure of a neuron with diagram. (CO3, L2)

(e) lymph nodes and spleen. (CO2, L2)

(f) Spinal cord and meninges. (CO3, L2)

(g) Outline the structure of major blood vessels. (CO5, L2)

(h) Describe digestive system and its parts. (CO4, L2)

(i) Explain male reproductive organs. **(**CO5, L2)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) Define homeostasis. (CO1, L1)

(b) Types of connective tissue. (CO2, L1–L2)

(c) Functions of diaphragm. (CO4, L2)

(d) Differentiate artery and vein. (CO2, L3)

(e) Functions of cerebellum. (CO3, L2)

(f) List hormones of thyroid gland. (CO5, L1)

(g) Identify anatomical landmarks for venipuncture. (CO6, L3)

Model Paper

B.MLS Semester-I
Code: BMLS102

Bachelor of Medical Laboratory Science
Semester I
Human Physiology
Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

a) Explain the composition and functions of blood. (CO2, L1)

b) Define the cardiac cycle and write the regulation of blood pressure. (CO5, L1)

c) Describe the hormones secreted by the pituitary glands with their functions. (CO6, L2)

Q.2. Short Essay Questions (Attempt any 7) 7 × 5 = 35 Marks

a) Define homeostasis and write its importance of the body. (CO1, L2)

b) Explain the structure of the cell membrane. (CO1, L2)

c) Classify blood groups. (CO2, L2)

d) Describe the mechanism of synaptic transmission. (CO3, L2)

e) Define the mechanics of respiration. (CO4, L2)

f) Explain the process of urine formation. (CO5, L3)

g) Write the functions of T-lymphocytes. (CO5, L2)

h) Write about the Cardiac output. (CO5, L3)

i) Role of ovarian hormones. (CO6, L2)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

a) Write the function of B- lymphocyte. (CO1, L1)

b) List any four functions of plasma proteins. (CO2, L1)

c) Define reflex arc. (CO3, L1)

d) Differentiate inspiration and expiration. (CO4, L2)

e) Define glomerular filtration rate (GFR). (CO5, L1)

f) Write short note on endocrine disorder. (CO6, L1)

g) List the functions of the placenta. (CO6, L2)

MODEL PAPER

B.MLS Semester-I
Paper Code: BMLS103

Bachelor of Medical Laboratory Science
Semester-I
Fundamentals of the Healthcare System and Medical Laboratory
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the healthcare delivery system in India at primary, secondary, and tertiary levels. (CO1, L-2)
(b) Describe the organization, classification, departments in patient care services. (CO2, L-2)
(c) Define laboratory safety measures including infection control and fire safety practices. (CO3, L-1)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Classify hospitals based on systems of medicine practiced in India. (CO1, L-2)
(b) Explain community participation in the healthcare delivery system. (CO1, L-2)
(c) Describe laboratory space planning in a clinical laboratory. (CO2, L-2)
(d) Write the laboratory organizational chart. (CO2, L-2)
(e) Explain biomedical waste management practices in healthcare institutions. (CO4, L-2)
(f) Describe the records maintained in laboratories as per ISO 15189 standards. (CO4, L-2)
(g) Explain the derivation of medical terminology using combining forms. (CO5, L-3)
(h) Identify common medical abbreviations used in healthcare settings. (CO5, L-1)
(i) Roles and responsibilities of NCAHP. (CO6, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define tertiary healthcare. (CO1, L-1)
(b) State the importance of laboratory visits. (CO2, L-1)
(c) Universal precautions in laboratories. (CO3, L-2)
(d) vaccination practices for laboratory personnel. (CO3, L-3)
(e) Use electronic health records in hospitals. (CO5, L-3)
(f) Registration requirements in healthcare practice. (CO6, L-2)
(g) Differentiate electrical safety measures in laboratories. (CO3, L-3)

MODEL PAPER

B.MLS Semester-I
Paper Code: BMLS104

Bachelor of Medical Laboratory Science
Semester- I
Communication Skills and Professional Values
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the communication process and importance of communication in healthcare settings. (CO1, L-2)
(b) Define verbal communication, non-verbal communication in professional practice. (CO3, L-1)
(c) Describe the preparation of CVs along with important interview skills required for career development. (CO5, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Influence of visual perception and language on communication. (CO2, L-2)
(b) Explain environment influence communication perspectives. (CO2, L-2)
(c) Summaries telephonic conversation skills. (CO3, L-2)
(d) Importance of personal appearance in professional etiquette. (CO4, L-3)
(e) Time management practices for attending classes and seminars. (CO4, L-2)
(f) list behavior and maintaining professionalism at the workplace. (CO4, L-1)
(g) Importance of frequently asked interview questions during recruitment. (CO5, L-2)
(h) Professional values including integrity and accountability. (CO6, L-2)
(i) Ethical values and mental health in personal development. (CO6, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks)

(a) Define communication. (CO1, L-1)
(b) Write the Methods to overcome physiological barriers to communication. (CO1, L-3)
(c) Use of body language in communication. (CO3, L-2)
(d) Greeting techniques in professional communication. (CO4, L-3)
(e) Differentiate resume and curriculum vitae. (CO5, L-2)
(f) Professional competence in healthcare practice. (CO6, L-2)
(g) Strategies to maintain mental health in professional life. (CO6, L-3)

MODEL PAPER

B.MLS Semester-I
Paper Code: BMLS105

Bachelor of Medical Laboratory Science
Semester-I
Basic Emergency care and First Aid
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the objectives and golden rules of first aid in emergency care. (CO1, L2)
(b) Classify first aid measures for hemorrhage and foreign body injuries in emergency situations. (CO3, L2)

(c) Define the techniques of cardiopulmonary resuscitation. (CO6, L1)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Qualities and responsibilities of a first aider during emergencies. (CO2, L-2)
(b) Simple first aid management for food poisoning and scorpion bite (CO3, L-2)
(c) Define shock and classify it types. (CO4, L-1)
(d) Initial first aid management of shock. (CO4, L-2)
(e) Poisoning and its sources and cause of poisoning. (CO4, L-1)
(f) Chain of survival and team dynamics during resuscitation. (CO5, L-2)
(g) Methods of measuring body temperature and pulse. (CO5, L-2)
(h) Define the Technique of pulse assessment. (CO6, L-3)
(i) Summaries the Bag-mask ventilation technique in Basic Life Support. (CO6, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Principles of first aid in emergency situation. (CO1, L1)
(b) Write the priorities of first aid while assessing an injured patient. (CO1, L3)
(c) Determine the first aid measures for a dog bite. (CO3, L3)
(d) Examine the symptoms of carbon monoxide poisoning for early identification. (CO4, L3)
(e) Appropriate antidote in common poisoning cases. (CO4, L2)
(f) Differentiate between systolic and diastolic blood pressure. (CO5, L2)
(g) Classify the normal range of respiration in adults. (CO5, L1)

MODEL PAPER

B.MLS Semester-I
Paper Code: BMLS106

Bachelor of Medical Laboratory Science
Semester-I
Basics of Computer Application
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the generations of computers and applications of computers in healthcare. (CO1, L-2)
(b) Classify the procedures of formatting and inserting images in Microsoft Word for medical documentation. (CO3, L-2)
(c) Define the role of electronic health records and hospital information systems. (CO6, L-1)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Input and output devices with suitable examples. (CO1, L-1)
(b) Features of Windows operating system and basic user interface operations. (CO2, L-2)
(c) File management procedures in an operating system. (CO2, L-2)
(d) Steps involved in slide creation using Microsoft PowerPoint. (CO4, L-3)
(e) Classify the basic formulas in Microsoft Excel. (CO4, L-2)
(f) Describe formatting cells and creating simple charts in Microsoft Excel. (CO4, L-2)
(g) Define computer networks and classify it. (CO5, L-1)
(h) Procedure for opening email accounts and attaching medical reports (CO5, L-2)
(i) Basic internet safety measures during online communication (CO5, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

Q1. Basic concept of a computer in healthcare settings. (CO1, L-2)
Q2. Computers for different applications in healthcare institutions. (CO1, L-1)
Q3. Differentiate between system software and application software. (CO2, L-2)
Q4. Use of Microsoft Access for managing healthcare data. (CO4, L-3)
Q5. Prepare simple charts using spreadsheet applications for data presentation. (CO4, L-3)
Q6. Use an internet browser to access healthcare-related information. (CO5, L-3)
Q7. Purpose of digital patient records in hospitals. (CO6, L-2)

MODEL PAPER

B.MLS Semester-II
Paper Code: BMLS201

Bachelor of Medical Laboratory Science
Semester-II
Fundamentals of Microbiology
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Define the historical development of microbiology from the discovery era to Golden Age. (CO1, L-1)

(b) Describe the structure of bacterial cell with well labelled diagram. (CO3, L-2)

(c) Classify methods of Sterilization. Write a detail note on moist heat sterilization. (CO4, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Explain the principles of dark-ground microscopy. (CO2, L-2)

(b) Describe the germ theory of disease. (CO1, L-2)

(c) Explain bacterial capsule with examples. (CO3, L-2)

(d) Classify the principle, procedure & interpretation of Gram Staining. (CO3, L-2)

(e) Describe the various phases of bacterial growth curve. (CO3, L-2)

(f) Enumerate the different methods of gene transfer. (CO3, L-2)

(g) Classify culture media on the basis of nutritional requirement. (CO4, L-2)

(h) Explain the various biochemical tests for identification of bacteria. (CO5, L-2)

(i) Classify the methods of antibiotic susceptibility testing. (CO5), L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks)

(a) Define selective media. (CO4, L-1)

(b) Use electron microscopy in microbiological diagnosis. (CO2, L-3)

(c) Demonstrate the negative staining technique. (CO3, L-3)

(d) Anaerobic culture methods for bacterial isolation. (CO4, L-2)

(e) Identify automated methods for bacterial identification. (CO5, L-3)

(f) Identify sources of infection in healthcare settings. (CO6, L-3)

(g) Dry heat sterilization. (CO4, L-1)

MODEL PAPER

B.MLS Semester-II
Paper Code: BMLS202

Bachelor of Medical Laboratory Science
Semester-II
Basic of Biochemistry
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the concepts of acids, bases and their applications in the clinical biochemistry laboratory. (CO1, L-2)

(b) Define the classification, structural organization, physical properties, and biological importance of proteins. (CO3, L-1)

(c) Discuss the biochemical functions and deficiency disorders of vitamin D. (CO5, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Write the preparation of molar solutions used in laboratories. (CO1, L-2)

(b) Describe osmosis, dialysis as biophysical phenomena. (CO1, L-2)

(c) Classify carbohydrate's structure and their biological importance. (CO2, L-2)

(d) Physical and chemical properties of lipids. (CO2, L-2)

(e) Classification and biological importance of amino acids. (CO3, L-2)

(f) Differentiate between DNA and RNA. (CO4, L-2)

(g) Classification of enzymes. (CO4, L-2)

(h) Describe factors influencing enzyme action. (CO4, L-2)

(i) Summaries the balanced diet and calorie requirements in nutrition. (CO6, L-3)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks)

(a) Define pH. (CO1, L-1)

(b) Use deionized water in laboratory procedures. (CO1, L-3)

(c) Demonstrate the preparation of a colloidal solution. (CO1, L-3)

(d) Functions of carbohydrates. (CO2, L-1)

(e) Differentiate nucleosides and nucleotides. (CO4, L-3)

(f) Calculate the respiratory quotient for a given condition. (CO6, L-3)

(g) Dietary modifications in protein-energy malnutrition. (CO6, L-2)

MODEL PAPER

B.MLS Semester-II
Paper Code: BMLS203

Bachelor of Medical Laboratory Science
Semester-II
Fundamentals of Hematology
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Define the composition and functions of blood. (CO1, L-1)
(b) Describe the different types of hemoglobin. (CO3, L-2)
(c) Explain the normal hemostasis, coagulation factors and fibrinolysis.(CO5, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Describe the bone marrow aspiration. (CO1, L-2)
(b) Explain the function and fate of erythrocytes. (CO2, L-2)
(c) Anisocytosis and poikilocytosis with their clinical significance. (CO2, L-2)
(d) Oxygen association and dissociation curve of hemoglobin. (CO3, L-2)
(e) Functions, lifespan, and normal range of leucocytes. (CO4, L-2)
(f) Quantitative and qualitative disorders of white blood cells. (CO4 L2)
(g) Write the functions of quantitative disorders of platelets. (CO4, L2)
(h) Principles of automation in hematology laboratories. (CO6, L3)
(i) Selection of anticoagulants for hematological investigations. (CO6, L3)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks)

(a) Cellular ratio of bone marrow. (CO1, L-1)
(b) Determine the normal erythrocyte count in adults. (CO2, L-3)
(c) Clinical use of glycosylated hemoglobin (HbA1c). (CO3, L-1)
(d) Physiological causes of leucocytosis. (CO4, L-1)
(e) Differentiate primary and secondary hemostasis. (CO5, L-3)
(f) Determine the erythrocyte sedimentation rate (ESR). (CO5, L-3)
(g) Romanowsky stain in hematological investigations. (CO6, L-2)

MODEL PAPER

B.MLS Semester-II
Paper Code: BMLS204

Bachelor of Medical Laboratory Science
Semester-II
Preventive and Social Medicine
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the epidemiological triad methods of disinfection used in healthcare settings. (CO1, L-2)

(b) Define the principles of primary health care role of in healthcare delivery. (CO2, L-2)

(c) Describe the health education and communication process in healthcare. (CO5, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Explain maternal and child health programs in India. (CO2, L-2)

(b) Describe occupational health services schemes. (CO2, L-2)

(c) Define factors influencing population growth. (CO3, L-2)

(d) Temporary methods of contraception used in family welfare programs. (CO3, L-2)

(e) Preventive measures of air pollution and noise pollution. (CO4, L-2)

(f) Biomedical waste management rules 2016 with colour coding. (CO4, L-2)

(g) Principles, and audiovisual aids used in health education. (CO5, L-2)

(h) First-aid management for bleeding, drowning, and convulsions. (CO6, L-1)

(i) Write the isolation methods used in communicable disease management. (CO6), L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks)

(a) Define the incubation period. (CO1, L-1)

(b) Role of the host in the spread of infectious diseases. (CO1, L-1)

(c) Family planning counselling in healthcare settings. (CO3, L-2)

(d) Objectives of Swachh Bharat Abhiyan in community health. (CO4, L-2)

(e) Write the behavioural change communication in health education. (CO5, L-1)

(f) Differentiate disease elimination and disease eradication. (CO4, L-3)

(g) Cardiopulmonary resuscitation during emergencies. (CO6, L-2)

MODEL PAPER

B.MLS Semester-III
Paper Code: BMLS301

Bachelor of Medical Laboratory Science
Semester-III
Bacteriology
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Define Gram Positive Bacteria and write the pathogenesis of Staphylococcus aureus. (CO1, L-1)

(b) Explain the cultural characteristics and pathogenesis of Escherichia coli. (CO3, L-2)

(c) Classify Spirochetes and write the lab diagnosis of syphilis. (CO4, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Classify Mycobacteria & its morphology (CO1, L-2)

(b) Explain the infections caused by non-spore-forming anaerobes. (CO2, L-2)

(c) Classify the *Clostridium* & explain gas gangrene (CO2, L-2)

(d) Describe the pathogenicity of *Neisseria gonorrhoeae*. (CO3, L-2)

(e) Explain the cultural characteristics of *Vibrio cholerae*. (CO4, L-2)

(f) Describe the laboratory identification of *Treponema pallidum*. (CO4, L-2)

(g) Explain the clinical significance of Candida infections. (CO4, L-2)

(h) Explain the lab diagnosis of urinary tract infections. (CO5, L-2)

(i) Write the prevention, and control of hospital-acquired infections. (CO6, L-3)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define the characteristic of *Corynebacterium diphtheriae*. (CO1, L-1)

(b) Identify the laboratory findings of *Clostridium tetani* infection. (CO2, L-3)

(c) Classify bacteria causing genital tract infections. (CO5, L-3)

(d) Differentiate *Pseudomonas aeruginosa* from other Gram-negative bacilli. (CO4, L-3)

(e) Laboratory laboratory diagnosis of *Mycoplasma pneumoniae*. (CO4, L-3)

(f) Spore-forming bacteria. (CO2, L-2)

(g) Bacteriological methods for air. (CO6, L-1)

MODEL PAPER

B.MLS Semester-III
Paper Code: BMLS302

Bachelor of Medical Laboratory Science
Semester-III
Intermediary Metabolism & Endocrinology
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Define the regulation of glycolysis in carbohydrate metabolism. (CO1, L-1)

(b) Discuss the physiological significance of cholesterol in the human body. (CO3, L-2)

(c) Explain the biochemical alterations occurring during starvation. (CO5, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Flow chart of the Tricarboxylic acid cycle. (CO1, L-2)

(b) Organization of the electron transport chain. (CO2, L-2)

(c) Beta-oxidation of fatty acids. (CO3, L-2)

(d) Explain the urea cycle and its significance in nitrogen metabolism. (CO4, L-2)

(e) Regulation of blood calcium level. (CO5, L-2)

(f) Biosynthesis of purines. (CO6, L-2)

(g) Explain the formation and breakdown of hemoglobin. (CO6, L-2)

(h) Determine the biochemical investigations useful in the diagnosis of diabetes mellitus. (CO5, L-3)

(i) Functions of major endocrine glands. (CO6, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define glycogenolysis. (CO1, L-1)

(b) Role of ATP synthase in oxidative phosphorylation. (CO2, L-2)

(c) Differentiate hyperlipidemia and fatty liver. (CO3, L-3)

(d) Characteristic features of phenylketonuria. (CO4, L-2)

(e) Determine the causes of dehydration. (CO5, L-3)

(f) Classify pyrimidines based on their biological importance. (CO6, L-3)

(g) Determine electrolyte abnormalities associated. (CO5, L-3)

MODEL PAPER

B.MLS Semester-III
Paper Code: BMLS303

Bachelor of Medical Laboratory Science
Semester-III
Clinical Hematology
Time: 3 Hours
Maximum Marks: 70
Minimum Marks: 40

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the red cell indices and their normal ranges and calculation (CO1, L-2)
(b) Discuss the pathophysiology and laboratory diagnosis of Chronic Myeloid Leukemia. (CO3, L-2)
(c) Define the interpretation of PT and factor assay results in bleeding disorders. (CO4, L-1)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Etiology and clinical features of Iron Deficiency Anemia. (CO2, L-2)
(b) Explain the etiological classification of anemia. (CO2, L-2)
(c) Clinical implications of Polycythemia Vera. (CO3, L-2)
(d) Cell-Based Model of Coagulation. (CO4, L-2)
(e) Pathophysiology of Von Willebrand Disease. (CO5 L-2)
(f) Principles of Fluorescence in Situ Hybridization (FISH) in hematological malignancies. (CO6, L-2)
(g) Applications of flow cytometry in hematological disorders. (CO6, L-2)
(h) Laboratory approach for diagnosis of Disseminated Intravascular Coagulation (DIC). (CO5, L-3)
(i) Recent advances in laboratory diagnosis of leukemia. (CO3, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define leukemoid reaction. (CO3, L-1)
(b) Identify the laboratory findings of megaloblastic anemia. (CO2, L-3)
(c) Differentiate Hemophilia A and Hemophilia B. (CO5, L-3)
(d) Classify the coagulation pathways in hemostasis. (CO4, L-3)
(e) Karyotyping in the diagnosis of genetic disorders. (CO6, L-2)
(f) Laboratory findings of hereditary spherocytosis. (CO2, L-2)
(g) Significance of mixing studies in coagulation testing. (CO4, L-2)

MODEL PAPER

B.MLS Semester-III
Paper Code: BMLS304

Bachelor of Medical Laboratory Science
Semester-III
Basics of Pharmacology
Time: 3 Hours / Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain pharmacokinetics with reference to absorption and excretion of drugs. (CO1, L-2)
(b) Describe the classification and resistance patterns of antibacterial drugs used in clinical practice. (CO3, L-2)
(c) Define the laboratory monitoring parameters used during anticoagulant therapy. (CO6, L3)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Routes of drug administration. (CO1, L-2)
(b) Explain the phases of clinical trials and their objectives. (CO2, L-2)
(c) Classify antitubercular drugs. (CO3, L-2)
(d) Relevance of antibiotic sensitivity testing in antimicrobial chemotherapy. (CO4, L-3)
(e) Oral hypoglycemic agents with their therapeutic uses. (CO5, L-2)
(f) Role of thyroid drugs in the management of thyroid disorders. (CO5, L-2)
(g) Use of hematinic in the management of anemia. (CO6, L-2)
(h) Determine the laboratory approach for monitoring antimicrobial therapy. (CO4, L-3)
(i) Therapeutic drug monitoring and its importance in patient care. (CO2, L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define pharmacodynamics. (CO1, L-1)
(b) Common adverse drug reactions in clinical practice. (CO1, L-2)
(c) Differentiate antifungal and antiviral drugs. (CO3, L-3)
(d) Classify corticosteroids based on their duration of action. (CO5, L-3)
(e) Determine the significance of drug half-life in drug therapy. (CO2, L-3)
(f) Blood products used in transfusion therapy. (CO6, L-2)
(g) Determine the effects of drugs on hematological parameters. (CO6, L-3)

MODEL PAPER

B.MLS Semester-IV
Paper Code: BMLS401

Bachelor of Medical Laboratory Science
Semester-IV
Virology and Immunology
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain various factors that affect the viral gowth. (CO1, L-2)
(b) Describe the methods of cultivation of viruses & laboratory diagnosis of viral infections (CO2, L-2)
(c) Define Immunity and write the mechanism of innate immunity. (CO5, L-1)

Q.2 Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Discuss RNA viruses with its morphology (CO3, L-2)
(b) Explain lytic & lysogenic life cycle. (CO1, L-2)
(c) Classify Hepatitis Virus & its mode of transmission. (CO3, L-2)
(d) Write the pathogenesis and laboratory diagnosis of HIV infection. (CO3, L-2)
(e) Explain the laboratory safety precautions followed in virology laboratories. (CO4, L-2)
(f) Describe the structure and functions of immunoglobulins. (CO5, L-2)
(g) Explain antigen-antibody reactions. (CO5, L-2)
(h) Discuss autoimmune diseases with examples (CO6, L-2)
(i) Differentiate active and passive immunization with suitable examples. (CO6, L-4)

Q.3 Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define viral taxonomy. (CO1, L-1)
(b) Write Arboviruses with examples. (CO3, L-2)
(c) Medically important DNA viruses. (CO3, L-2)
(d) Antiviral drugs in the management of viral infections. (CO4, L-2)
(e) Antigens based on their types. (CO5, L-2)
(f) Differentiate the types of hypersensitivity reactions. (CO5, L-3)
(g) Monoclonal antibodies in disease diagnosis. (CO5, L-2)

MODEL PAPER

B.MLS Semester-IV
Paper Code: BMLS402

Bachelor of Medical Laboratory Science
Semester-IV
Genetics and Molecular Biology
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the principles of Mendelian inheritance and discuss ABO blood group inheritance. (CO1, L-2)
(b) Define the chromosomal aberrations and explain their genetic consequences. (CO2, L-1)
(c) Explain the regulation of gene expression in eukaryotes. (CO5, L-2)

Q.2 Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Explain the principle & applications of Phase contrast microscopy (CO6 L-2)
(b) Describe the structure and functions of centromere. (CO2, L-2)
(c) Explain the significance of mitosis. (CO3, L-2)
(d) Discuss the structure of DNA and its biological importance. (CO4, L-2)
(e) Explain different types of gene mutations. (CO4, L-2)
(f) Describe the genetic code and its characteristics. (CO5, L-2)
(g) Write the applications of PCR in molecular diagnostics. (CO6, L-2)
(h) Classify blotting techniques with its applications (CO6, L-2)
(i) Explain the principle and applications of DNA sequencing. (CO6, L-2)

Q.3 Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) State the Principle of Segregation. (CO1, L-1)
(b) Classify aneuploidy with suitable examples. (CO2, L-3)
(c) Differentiate transcription and translation. (CO5, L-4)
(d) Classify mutations based on their types. (CO4, L-3)
(e) Functions of RNA polymerases. (CO5, L-1)
(f) Real-Time PCR in disease diagnosis. (CO6, L-2)
(g) Compare Real-Time PCR and conventional PCR. (CO6, L-4)

MODEL PAPER

B.MLS Semester-IV
Code: BMLS403

Bachelor of Medical Laboratory Science
Semester IV
Clinical Pathology
Time: 3 Hours
Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

a) Explain the physical and chemical examination of pathological urine. (CO1, L-2)
b) Classify the laboratory findings of cerebrospinal fluid (CSF) in normal urine. (CO4) (L-4)
c) Explain the role of automation and recent advances in clinical pathology for disease diagnosis. (CO6) (L-2)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

(a) Collection of urine specimens. (CO1, L-2)
(b) Detection of urinary glucose and ketone bodies. (CO2, L-3)
(c) Write the microscopic examination of urine. (CO2, L-2)
(d) chemical examination of stool. (CO2, L-2)
(e) Laboratory examination in respiratory diseases. (CO3, L-2)
(f) Explain the examination of amniotic fluid. (CO4, L-2)
(g) Describe automation and recent advances in clinical pathology laboratories. (CO5, L-4)
(h) Method of collection semen samples. (CO4) (L-2)
(i) Occult blood testing and its clinical importance. (CO2, L-3)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) Define specific gravity of urine. (CO1, L-1)
(b) Significance of chyluria in urine examination. (CO2, L-3)
(c) Any one Laboratory methods for the detection of azoospermia. (CO3, L-2)
(d) Clinical significance of pleural fluid examination. (CO4, L-2)
(e) Examine the diagnostic uses of bronchoalveolar lavage (BAL). (CO4, L-4)
(f) Differentiate synovial fluid and pleural fluid. (CO5, L-3)
(g) Scotch tape preparation technique. (CO3, L-2)

MODEL PAPER

B.MLS Semester-IV
Paper Code: BMLS404

Bachelor of Medical Laboratory Science
Semester-IV
Medical Laboratory Management and Quality Control
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Explain the laboratory errors and Corrective and preventive action. (CO1, L-2)
(b) Describe internal and external quality control. (CO2, L-2)
(c) Define automation in laboratory workflow, and the role of AI. (CO4, L-3)

Q.2 Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Three phases of the laboratory testing process. (CO1, L-2)
(b) Benefits of accreditation in medical laboratories. **(CO3) (L-2)**
(c) Role of NABL and ISO. (CO3, L-2)
(d) Explain the importance of laboratory audit. (CO3, L-3)
(e) Describe the dry chemistry analyzers. (CO4, L-2)
(f) Explain the principle of Point-of-Care Testing (POCT). (CO4, L-3)
(g) Write the components of Laboratory Information Systems (LIS). (CO5, L-2)
(h) Explain sample management and instrument integration in LIMS. (CO5, L-3)
(i) Describe green laboratory practices for sustainable clinical laboratories. (CO6, L-4)

Q.3 Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define the urine dipstick method. (CO5, L-1)
(b) Write the principle of continuous flow in laboratory automation. (CO1, L-2)
(c) Audit findings to improve laboratory quality. (CO4, L-2)
(d) L-J (Levey–Jennings) chart for quality control. (CO4, L-1)
(e) Basic steps of calibration in laboratory instruments. (CO5, L-3)
(f) Apply the functions of LIMS in laboratory data management. (CO5, L-3)
(g) Robotic Process Automation (RPA) in laboratory practice. (CO6, L-2)

MODEL PAPER

B.MLS Semester-V
Paper Code: BMLS501

Bachelor of Medical Laboratory Science
Semester-V
Mycology & Parasitology
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Classify Mycoses and write the laboratory diagnosis of Dermatophytosis (CO2, L-2)
(b) Explain the morphology, life cycle & lab diagnosis of malarial parasite. (CO4, L-2)
(c) Describe the life cycle and lab diagnosis of any one of them. (CO 5, L-2)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Classify medically important fungi with examples. **(**CO, L-2)
(b) Explain the lab diagnosis of Histoplasmosis (CO2, L-2)
(c) Explain characteristic features of fungi that differentiates from bacteria. (CO1, L-2)
(d) Explain various techniques used for identification of fungi. (CO2, L-2)
(e) Describe the morphology and life cycle of *Entamoeba histolytica*. (CO4, L-2)
(f) Write the lab diagnosis of parastic infections. (CO4, L-2)
(g) Describe the life cycle and laboratory diagnosis of *Enterobius vermicularis*. (CO5, L-2)
(h) Explain the lab diagnosis of Candidiasis. (CO2, L-2)
(i) Explain the role of arthropods in the transmission of diseases. (CO4) (L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) List the species of *Plasmodium* causing malaria. (CO1, L-1)
(b) Identification of mycotoxicosis in a clinical case. (CO3, L-3)
(c) Write the definitive host in common parasitic infections. (CO1, L-2)
(d) Egg of *Ascaris lumbricoides* based on its characteristic features. (CO5, L-2)
(e) Xenodiagnosis in the diagnosis of parasitic diseases. (CO6, L-2)
(f) Differentiate opportunistic mycoses from primary mycoses with examples. (CO2, L-3)
(g) Serological tests used in the diagnosis of infectious diseases. (CO6, L-2)

MODEL PAPER

B.MLS Semester-V
Paper Code: BMLS502

Bachelor of Medical Laboratory Science
Semester-V
Analytical Biochemistry
Time: 3 Hours | Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Discuss the principles, instrumentation, and applications of spectrophotometry. (CO1) (L-2)
(b) Describe the principles and laboratory applications of chromatography. (CO3) (L-2)
(c) Define the role of automation and immunoassays in modern clinical laboratories. (CO6) (L-1)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Principle and types of centrifugations in laboratory. **(**CO2) (L-2)
(b) Explain the principle of Thick Layer Chromatography. (CO3) (L-3)
(c) Describe PAGE electrophoresis. (CO4) (L-3)
(d) Principle of Atomic Absorption Spectroscopy. (CO1) (L-2)
(e) Principle and clinical significance of osmometry. (CO5) (L-4)
(f) Explain safety precautions while handling radioisotopes. (CO5) (L-3)
(g) Describe the applications of ELISA. (CO6) (L-3)
(h) Explain fully automated chemistry analysers used in clinical laboratories. (CO6) (L-3)
(i) Properties and hazards of radioactive materials used in laboratories. (CO5) (L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define flame photometry. (CO1, L-1)
(b) Use of a centrifuge in sample separation. (CO2, L-3)
(c) Applications of gas chromatography in clinical laboratories. (CO3, L-2)
(d) Capillary electrophoresis for the separation of biomolecules. (CO4, L-2)
(e) Determine the clinical use of osmometry in laboratory practice. (CO5, L-3)
(f) Write the Principles of radioactivity in diagnostic laboratory techniques. (CO5, L-3)
(g) Differentiate ELISA and CLIA in clinical diagnostics. (CO6, L-3)

MODEL PAPER

B.MLS Semester-V
Paper Code: BMLS503

Bachelor of Medical Laboratory Science
Semester-V
Immunohematology & Transfusion Medicine
Time: 3 Hours
Maximum Marks: 70

Q.1 Essay Questions (Answer any 2 out of 3) (2×10= 20 Marks)

(a) Discuss donor selection criteria, and management of donor. (CO1) (L-2)
(b) Explain the ABO and Rh blood group. (CO2) (L-2)
(c) Evaluate transfusion reactions and their laboratory investigations in transfusion practice. (CO5) (L-5)

Q.2 – Short Essay Questions (Answer any 7 out of 9) (7×5= 35 Marks)

(a) Autologous blood transfusion and its advantages. **(**CO1) (L-2)
(b) Types of blood bags with their advantages. (CO1) (L-2)
(c) Preparation and storage of Fresh Frozen Plasma (FFP). **(**CO3) (L-3)
(d) Describe platelet concentrate with indications. (CO3) (L-3)
(e) Write the procedure of major cross-matching. (CO4) (L-3)
(f) Describe pre-transfusion testing. (CO4) (L-3)
(g) Explain transfusion-transmitted diseases. (CO5) (L-4)
(h) Describe the clinical applications of HLA testing. (CO6) (L-2)
(i) Explain quality management and biosafety practices. (CO6) (L-2)

Q.3 – Short Answer Questions (Answer any 5 out of 7) 5 × 3 = 15 Marks

(a) Define hemapheresis. (CO1, L-1)
(b) Clinical significance of the Bombay phenotype. (CO2, L-2)
(c) Write the of packed red cells in blood transfusion. (CO3, L-2)
(d) Write the importance of weak D antigen testing in blood grouping. (CO2, L-2)
(e) Write preventive measures for haemolytic disease of the newborn (HDN). (CO5, L-3)
(f) Clinical use of cryoprecipitate in bleeding disorders. (CO3, L-2)
(g) Differentiate external quality control in transfusion medicine. (CO6, L-3)

MODEL PAPER

B.MLS Semester-V
Paper Code: BMLS504

Bachelor of Medical Laboratory Science
Semester-V
Medical Law and Ethics
Time: 3 Hours
Maximum Marks: 70

MODEL PAPER

B.MLS Semester-VI
Paper Code: BMLS601

Bachelor of Medical Laboratory Science
Semester-VI
Applied Pathobiology
Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

(a) Explain the mechanisms of cellular injury and cell death. (CO1, L-2)

(b) Analyze the vascular and cellular events involved in chronic inflammation. (CO2, L-4)

(c) A 30-year-old patient presents with fever, cough, and sputum production for 5 days. Design a stepwise laboratory diagnostic approach to identify the infectious cause, including: (CO, L4)

1. Selection of appropriate clinical samples
2. Microscopic examination methods
3. Culture techniques
4. Serological and molecular tests

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

(a) Classify cellular adaptations with suitable examples. (CO1, L-1)

(b) Pathological calcification and intracellular accumulations with examples. (CO2, L-2)

(c) Stages of wound healing and factors affecting wound healing. (CO1, L-2)

(d) Differentiate transudate and exudate. (CO3, L-3)

(e) Describe thrombosis and embolism. (CO2, L-2)

(f) Describe autoimmune disorders with suitable examples. (CO2, L-4)

(g) Differences between benign and malignant tumors. (CO1, L-1)

(h) Write the laboratory diagnostic methods used for pulmonary tuberculosis. (CO3, L-2)

(i) Tumor markers and clinical significance of neoplasia (CO3, L5)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) Define the types of necrosis. (CO1, L-1)
(b) Determine the significance of apoptosis in tissue homeostasis. (CO2, L-3)
(c) Identify the characteristic features of a granuloma. (CO1, L-3)
(d) Initial management of shock. (CO2, L-2)
(e) Differentiate atrophy and hypertrophy. (CO1, L-3)
(f) Clinical uses of tumor markers. (CO3, L-2)
(g) Infections included in the TORCH complex. (CO2, L-2)

MODEL PAPER

B.MLS Semester-VI
Paper Code: BMLS602

Bachelor of Medical Laboratory Science
Semester-VI

Cytology and Histopathology | Paper- II
Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

(a) Describe the **organisation of a cytology laboratory** and explain the workflow from sample collection. (CO1, L-2)
(b) Write in detail tissue processing in histopathology. (CO4, L-3)
(c) Explain procedure and diagnostic significance of routine staining in histopathology. (CO5, CO6, L-4)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

(a) Different types of cytology. (CO1, L-1)
(b) Role of Pap stain in screening cervical lesions. (CO2, L-2)
(c) Fluid cytology with reference to sputum and body fluids. (CO2, L-2)
(d) Illustrate the principles and applications of liquid-based cytology. (CO3, L-3)
(e) Explain the classification of fixatives. (CO4, L-2)
(f) Causes and remedies of defective tissue sections. (CO4, L-3)
(g) Procedure of H&E staining in tissue sections. (CO5, L-3)
(h) Principles and uses of PAS stain. (CO5, L-2)
(i) S**ample acceptance and rejection criteria** in cytology. (CO1, L-4)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) Define automation in cytology. (CO1, L-1)

(b) Determine aspiration cytology in the diagnosis of superficial lesions. (CO2, L-3)

(c) Write the applications of the cell block technique in cytology. (CO3, L-2)

(d) Write the decalcification techniques in histopathology specimen processing. (CO4, L-2)

(e) Determine the clinical use of frozen section examination. (CO4, L-3)

(f) Write the immunohistochemistry in the diagnosis of tumors. (CO5, L-2)

(g) Differentiate frozen section and paraffin section techniques. (CO6, L-3)

MODEL PAPER

B.MLS Semester-VI
Paper Code: BMLS603

Bachelor of Medical Laboratory Science
Semester-VI
Clinical Biochemistry
Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

(a) Explain GCLP guidelines including laboratory safety and specimen collection, in clinical biochemistry laboratories. (CO1, L-2)
(b) Analyze cardiac function tests and enzyme patterns in acute myocardial infarction. (CO5, L-4)
(c) A 45-year-old male presents with **yellowish discoloration of eyes and skin**, dark urine, and fatigue for the past 5 days. He has a history of alcohol consumption. On examination, mild hepatomegaly is noted.
   1) Which **serum enzymes** would you investigate in this case? Explain their diagnostic importance in liver disease. (L4)
   2) Based on the clinical presentation, classify the type of **jaundice**. Justify your answer with relevant laboratory findings. (L4)
   3) Define **Liver Function Tests (LFTs)** and mention any **two indications** for performing LFT. (L1)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

(a) Analytical phase of laboratory testing. (CO2, L-2)
(b) Internal and external quality control methods in clinical biochemistry. (CO2, L-2)
(c) Write the rules and Levey–Jenning's chart in laboratory quality control. (CO2, L-3)
(d) Laboratory diagnosis of diabetes mellitus. (CO3, L-2)
(e) Screening tests for inborn errors of metabolism. (CO3, L-2)
(f) Renal function tests and their clinical significance. (CO4, L-2)
(g) Write the acid-base balance and blood gas analysis in clinical diagnosis. (CO4, L-3)
(h) Pancreatic function tests. (CO4, L-2)
(i) Thyroid function tests and their clinical importance. (CO4, L-2)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) Glycated hemoglobin (HbA1c). (CO1, L-1)
(b) Determine the importance of proper sample storage. (CO2, L-3)
(c) Identify the clinical indications for the Oral Glucose Tolerance Test (OGTT). (CO3, L-3)
(d) Determine the components of a lipid profile and their clinical significance. (CO4, L-3)
(e) Identify the diagnostic importance of cardiac biomarkers. (CO5, L-3)
(f) Differentiate alpha-fetoprotein (AFP) and carcinoembryonic antigen (CEA). (CO6, L-4)
(g) Determine the significance of carcinogenesis in cancer development. (CO6, L-3)

MODEL PAPER

B.MLS Semester-VI
Paper Code: BMLS604

Bachelor of Medical Laboratory Science
Semester-VI
Biostatistics & Research Methodology
Time: 3 Hours | Maximum Marks: 70

Q.1. Essay Questions (Attempt any 2) **2 × 10 = 20 Marks**

(a) Define research methodology. Explain its components including research design, data collection methods, and data sources. (CO1, L-2)
(b) Describe descriptive statistics including measures of dispersion such as range and coefficient of variation. (CO2, L-2)
(c) Evaluate hypothesis testing methods including Chi-square test and Mann- Whitney U test using statistical software. (CO5, L-4)

Q.2. Short Essay Questions (Attempt any 7) **7 × 5 = 35 Marks**

(a) Frequency distribution and graphical representation of data. (CO1, L-2)
(b) Describe probability and normal distribution. (CO2, L-2)
(c) Illustrate probability and non-probability sampling methods. (CO3, L-3)
(d) Explain correlation and its types with scatter plot representation. (CO4, L-2)
(e) Apply simple linear regression for prediction in biomedical data. (CO4, L-3)
(f) Describe research design and its types in biomedical research. (CO6, L-2)
(g) Methods of data collection. (CO6, L-2)
(h) Review of literature and its importance in research. (CO6, L-2)
(i) Sampling errors and non-sampling errors in research studies. (CO3, L-2)

Q.3. Short Answer Questions (Attempt any 5) **5 × 3 = 15 Marks**

(a) Inter-quartile range (CO1, L-1)
(b) What is variance (CO2, L-1)
(c) ANOVA (CO5, L-1)
(d) What is sampling. (CO3, L-1)
(e) Define correlation. (CO4, L-1)
(f) What is secondary data. (CO5, L-1)
(g) Significance of Biostatistics (CO6, L-1)

Principal
MG Institute of Allied Health Sciences
Jaipur

Dr. Bushra Fiza
Dean, Faculty of Allied and Healthcare Professions
MGUMST, Jaipur