THE APOLLO UNIVERSITY

DIVISION OF ALLIED HEALTH SCIENCES

SCHOOL OF HEALTH SCIENCES

COURSE STRUCTURE & SYLLABI

B.Sc. MEDICAL LABORATORY TECHNOLOGY

FOR 2023, 2024 & 2025 ADMITTED BATCH

Program Outcomes (PO)

The Program is designed to provide the knowledge and skills needed to become an effective healthcare professional. The broad goal of the Program is to provide students with a foundation in content and supporting skills/competences that will support their development as effective healthcare professionals.

The Program Outcomes of Allied Health Sciences are summarized below:

PO 1: Clinical care: Organize and implement the prescribed preventive, investigative and management plans; and will offer care and appropriate follow-up services to patients in a cost- effective way.

PO 2: Communication: Communicate effectively and appropriately with patients/clients, caregivers, other health professionals and other members of the community.

PO 3: Membership of a multidisciplinary health team: Function effectively as an individual, and as a member in multidisciplinary healthcare teams to accomplish shared goals within and across settings to achieve coordinated, high-quality care.

PO 4: Ethics and accountability at all levels: Understand the core concept of clinical ethics and law so that they may apply these to their practice as healthcare service providers.

PO 5: Commitment to professional excellence: Execute professionalism and reflect technical competence, appearance, empathy, compassion, honor, and integrity in his/her thought and action to ensure the safe delivery of healthcare.

PO 6: Leadership and mentorship: Demonstrate leadership qualities where needed to ensure clinical productivity and patient satisfaction in an autonomous and confident manner.

PO 7: Social accountability and responsibility: Recognize that allied health professionals need to judiciously manage resources and promote innovation and sustainability to provide optimal patient care in a socially responsible manner.

PO 8: Scientific attitude and scholarship: To be engaged in evidence-based practice and need- based research studies and to apply and disseminate research findings and knowledge for improving the quality of care.

PO 9: Lifelong learning: Recognize the need and have the ability to engage in independent and continuous lifelong learning and improvement in skills and knowledge while harnessing modern tools and technology for the advancement of self and profession.

PROGRAM EDUCATIONAL OBJECTIVES (PEO):

PEO1: Professional Competence: Equip graduates with the knowledge and technical expertise to perform accurate and efficient diagnostic tests in clinical laboratories.

PEO2: Ethical Practice and Professionalism: Instil ethical responsibility, professionalism, and integrity in laboratory practices, ensuring adherence to regulatory standards and patient confidentiality.

PEO3: Critical Thinking and Problem-Solving: Develop critical thinking and analytical skills for interpreting laboratory data and troubleshooting technical issues in laboratory procedures.

PEO4: Lifelong Learning and Adaptability: Encourage continuous professional development and adaptability to evolving technologies and methodologies in medical laboratory technology

PEO5: Foster effective communication and collaboration: Graduates collaborate with healthcare professionals, convey accurate test results, and enhance patient care through interdisciplinary teamwork

PROGRAM-SPECIFIC OUTCOMES (PSO):

After successful completion of the program the graduates will be able to:

PSO1: Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Pathology, Biochemistry, Immunohematology, and Microbiology under the general supervision of a Clinical Laboratory Scientist.

PSO 2: Demonstrate technical skills, social behavior, and professional awareness incumbent upon a laboratory technician.

PSO 3: Apply systematized problem-solving techniques to identify and correct procedural errors, identify instrument malfunctions, seek proper supervisory assistance, and verify the accuracy of laboratory results obtained.

PSO 4: Operate and maintain laboratory equipment, utilizing appropriate quality control and safety procedures.

PSO 5: Recognize and participate in activities which will provide current knowledge and upgrading of skills in laboratory medicine or health science.

THE APOLLO UNIVERSITY
ACADEMIC REGULATIONS

SCOPE:

This Academic regulation provide a framework for the regulatory guidelines of all programs offered by The Apollo University. It includes procedures and practices that are to be followed to ensure academic standards in the University. The regulations are approved by the Academic Council. These regulations may be amended from time to time with the approval of the Academic council for the benefit of students or sometimes to reflect the changes suggested by the statutory bodies.

Information regarding amendments (if any) to the regulations will be communicated to the students by publishing them on the University website. Students must follow the amended regulations as they might impact the process for the award of degree. The decision of the Vice Chancellor shall be the final in case of any discrepancy. These regulations apply to all students, despite the study program.

1. ADMISSION INTO THE PROGRAM

The University admits the students in two modes. One through the convenor quota as per the Andhra Pradesh Private Universities Act, for which the admissions will be carried out through the convener quota by the Govt of Andhra Pradesh. The other is through University quota for which the following procedure will be followed:

A. The applicant shall satisfy the entrance requirements specified by The Apollo University and in accordance with guidelines of statutory councils for Under-graduation.
B. The Applicant shall be qualified in the qualifying examination for a particular program.
C. The Applicant secures a rank in national level entrance exam, or suitable such test conducted by The Apollo University / professional body.
D. The Applicant qualifies in the specified state or national level examinations prescribed by The Apollo University.

The Apollo University will widely notify the counselling schedule for admissions into the academic programs in the media. The provisional admission will be given to the eligible students during the counselling scheduled by Apollo University. The selected candidates will be provisionally admitted into the program of his/her choice if the candidate meets the program specific requirements in addition to

academic performance qualifying exam. Admission is purely based on merit and so merely meeting the requirements will not ensure admission. The University does not discriminate based on gender, race, region, religion, disability or nationality. The University reserves the right to make admissions based on various criteria which is specified in the admission brochure.

2. ELIGIBILITY CRITERIA

Undergraduate programs

The qualifying exam eligibility for each program is given Annexure 1. The student should have passed the qualifying exam either in the year the student is seeking admission or the previous year.

Convener Quota: The student seeking admission to any program under convener quota shall qualify in the relevant entrance exam conducted by the Government of Andhra Pradesh.

University Quota: For getting admission under University quota, percentage of marks obtained in the qualifying exam, the rank obtained in TAU entrance exam or any recognized national level examination in the year of admission will be considered.

Counselling

All the eligible students need to apply for admission and have to attend counselling conducted by TAU as per the schedule for the university quota.

3. PROGRAMS

The Apollo University offers a variety of programs which includes certificate, undergraduate, postgraduate, and Research. The list of programs on offer for the academic year 2023-24 are annexed in Annexure 2.

Minimum duration of the program

The minimum duration of each program depends on the type of program, viz., undergraduate, postgraduate, integrated programs, etc., and the faculty which offers the program. The maximum duration of the program is N+2 years, where N stands for the minimum duration of the program as mentioned in Annexure 2 and 3. If the student has not obtained the minimum number of credits within the stipulated time, the Vice-Chancellor may extend the maximum duration in extenuating circumstances upon receiving a request along with reasons from the student for not completing the program on time.

4. CHOICE BASED CREDIT SYSTEM

The choice-based credit system (CBCS) facilitates the education student-centric. It provides the opportunity for the learner to choose the courses from a basket of core, elective, and skill enhanced courses. All

programs of study are designed to meet the specified number of credit requirements. The courses taken by the student in each semester as part of the program are allotted some credit points based on the number of hours assigned. Upon successful completion of the course, the student secures the number of credits allotted for that course. Once the minimum number of credits for the program is achieved, the degree can be awarded, subject to fulfilment of all other relevant conditions.

5. STRUCTURE OF THE PROGRAM

The Program structure Consists of

i) University Courses
   - A. University Core
   - B. University Electives

ii) Faculty Courses
   - A. Faculty Core
   - B. Faculty Electives

iii) Program Courses
   - A. Program Core
   - B. Program electives

Each course* is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. (*one course means one subject)

Core Courses = 3 Credits /4 Credits **Elective =3 Credits**

In general, credits are assigned to the courses as detailed below:

- **A classroom lecture/ tutorial of 60 min (1 hr) duration per week, spread over the entire semester, shall be considered as one credit.**
- **A laboratory session of a minimum of 120 min (2 hr) per week shall be considered as one credit.**
- **A project work/ Internship session of 60 minutes (1 hr) carried out per week shall be considered as one credit.**

6. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

7. REGISTRATION

Any of the following students must register for the courses opted in a particular semester during the scheduled registration period.

i. a new student who enrolls into any program
ii. an existing student who is continuing on rolls from the preceding regular semester
iii. a former student, i.e., who has not enrolled in the preceding regular semester or who has availed academic break or detained and got readmission

Each newly admitted student shall attend an induction/ orientation program prior to commencement of the first semester. During this program academic advisors assist the students in choosing the courses. Existing students may register online by using their registration number and mail ID through the Apollo ERP portal. Class schedules are available approximately two weeks before the beginning of every semester for each program. The concerned head of the department must approve class schedule.

8. ATTENDANCE REQUIREMENTS

- Students should earn a minimum of 80% attendance in the current semester to become eligible to write the Semester End Examinations.
- The monthly statement of attendance will be displayed on the Department Notice Board/ Apollo ERP by the respective departments within the first five working days of the following month.
- Candidates who are falling short of 80% attendance will be detained on the recommendation of the HoD and are not eligible to appear for the current semester examinations. The students who are detained in the current semester will not be allowed to register for the next semester and they have to repeat the same semester by paying the tuition fee prescribed. However, they can write arrear subjects, if any.

9. EVALUATION

The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks). A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination. Clinical Skill/Practical/ Project Work/ Industrial Training/ Viva voce/ Seminar etc. are completely assessed as Continuous Evaluation (80 marks) and Semester-end examination (20 marks) put together a maximum of 100 marks, and a student has to obtain a minimum of

50% to secure Pass Grade. For courses having both theory and practical components, 60% of the weightage will be given for theory component and 40% weightage for practical component. The student must secure 40% (Theory + Practical) with 24 marks minimum in theory to attain pass grade.

Details of Assessment Procedure are furnished below in Table 1.

Table 1: Assessment Procedure

S. No.	**Component of Assessment**	**Marks Allotted**	**Type of Assessment**	**Scheme of Evaluation**
1	Theory	40	Continuous Evaluation	i) Twenty (20) marks for mid examinations. Three mid examinations shall be conducted for 20 marks each; average of the best two performances shall be taken into consideration. ii) Ten (10) marks for Quizzes, Assignments and Presentations. iii) Ten (10) marks for periodic evaluation, case studies and projects
		60	Semester-end Examination	iv) Sixty (60) marks for Semester-end examinations
	Total	**100**		
2	Laboratory	100	Continuous Evaluation	1)80 marks with equal weightage to all experiments subject to conduct of minimum of 10 experiments 2)20 marks for the end exam (with one of our university teachers as external other than course teacher)

3	Internship	100	Continuous Evaluation	i) (80) marks for periodic evaluation of Internship report by the Project Supervisor. ii) Twenty (20) marks for final Report presentation and Viva-voce, by a panel of internal examiners. iii) Students shall undergo TWO internships during the course of time and the evaluation shall be done during final semester.
4	Project work	100	Continuous Evaluation	iv) (80) marks for periodic evaluation and technical report writing by the Project Supervisor. ii) Twenty (20) marks for final Report presentation and Viva-voce, by a panel of internal examiners

GRADING SYSTEM

Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given inTable2.

Table 2: Grades & Grade Points

Sl. No.	**Grade**	**Grade Points**	**Absolute Marks**
1	O(Outstanding)	10	90 and above
2	A+(Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+(Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C(Average)	5	45 to 49
7	P(Pass)	4	40 to 44

8	F(Fail)	0	Less than 40
9	Ab. (Absent)	0	-

SEMESTER GRADEPOINTAVERAGE (SGPA)

A Semester Grade Point Average (SGPA) for the semester will be calculated according to the formula:

$$SGPA \frac{\sum [C X G]}{\sum C}$$

Where

C = Number of credits for the course,

G = Grade points obtained by the student in the course.

A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course.

CUMULATIVE GRADE POINT AVEARGE (CGPA)

A similar formula is used to arrive at Cumulative Grade Point Average (CGPA), considering the student's performance in all the courses taken in all the semesters up to the particular point of time.
Table 3 shows the CGPA required for the award of class after the successful completion of the program.

Table3: CGPA required for award of Class

Class	**CGPA Required**
First Class with Distinction	≥8.0*
First Class	≥6.5
Second Class	≥5.5
Pass Class	≥5.0

*In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in first attempt.

11. REAPPEARANCE

a. A student who has secured 'F' grade in a Theory course shall have to reappear at the subsequent Semester end examination held for that course.
b. A student who has secured 'F' grade in a Practical course shall have to attend Special Instruction Classes scheduled by the Department for securing pass.
c. A student who has secured 'F' Grade in Internship /Project work / Industrial Training etc shall have to reappear for Viva – voce scheduled by the department.
d. A student who is declared fail (F) in a course/s can apply for revaluation within one week from the date of publication of results with a fee prescribed by the university. The marks /grade awarded in the revaluation is final.

11.1 PROCEDURE FOR REVALUATION

- The students who have not satisfied with the marks awarded by the examiner can apply for revaluation of his/her answer script/s
- The students have to apply through proper channel for revaluation and to pay the revaluation fee per paper to the university towards revaluation fee.
- Students have to apply for revaluation within 7 days from the date publication of result.
- The scripts will get valued by second examiner and if the difference is more than 15 marks, they will get valued by the third examiner. The average of the nearest two marks will be declared as the final marks.

11.2 ASSESSMENT MECHANISM

The Apollo University offers students the benefits of Choice Based Credit System. Every paper is allotted a certain number of credits as per the UGC norms. A student is awarded the specified credits on obtaining a pass in the respective paper.

The Choice Based Credit System (CBCS) has been adopted for UG Course from the year 2021-22 onwards as per the recommendations of the A.P. State Council for Higher Education (APSCHE). The structure of undergraduate programmes provides a wide range of choice for students to opt for courses based on their eligibility, aptitude and career goals.

11.3 SEMESTER END EXAMINATION

The End semester examination will be a comprehensive examination of 3 hours duration. Two End

Semester examinations are conducted in a year-

Odd semester examinations in November/ December and

Even semester examination in May/June

Practical examination / Project viva will be held 2 weeks prior to the theory semester end examinations.

Under-Graduation Programs

Course	Continuous Assessment	End semester	Aggregate in End semester Examinations
All UG Courses	No passing minimum	40%	40%

11.4 POST EVALUATION PROGRAMME:

Under the Post Evaluation Programme there are three menus:

- Provision for improvement
- Re-totalling and Revaluation of answer scripts
- Restrictions to appear for the examinations

11.5 PROVISION FOR IMPROVEMENT:

A student who passes a paper in the first attempt can reappear for the same paper in the succeeding End-of-Semester examination only, for improving his/her marks. Re-appearance for improvement is allowed for theory and practical subjects of all semesters, except for the final semester subjects. Revised mark statement will be issued after withdrawing the previous one, if the marks obtained in improvement are higher than the marks awarded earlier. When there is no improvement, there shall not be any change in the original marks already awarded. The improved marks shall be considered for classification but not for ranking.

Provision for Re-totalling and Revaluation of valued answer scripts

- UG candidates may apply for re-totalling / revaluation of valued answer scripts, to the Controller of Examinations through the Heads of Departments and Principal / Dean, in the prescribed forms, remitting the prescribed fee within 7 days from the date of publication of results. Revaluation of answer scripts is permissible only for the current semester papers and not for any arrear paper.
- Those wish to apply for revaluation of final semester papers can do so within five days from the date of publication of results. In re-valuation, the answer papers will be valued by an external examiner and if there is a difference of 15 marks between the two evaluations then the script will

be sent for third valuation which is final and the mark awarded by the third examiner will be taken into the account.

- Revised mark statement will be issued after withdrawing the previous one, if the marks obtained in revaluation / retotalling are higher than the marks obtained earlier. In other cases, the original marks obtained earlier will be retained and the matter will be intimated to the student concerned as 'No change'.
- A candidate who applies for revaluation should not apply for retotalling.

RESTRICTIONS TO APPEAR FOR THE EXAMINATIONS

Candidates who fail in any of the papers in the UG End semester examinations shall complete the paper concerned within N+2 years from the date of admission to the particular course. If they fail to do so, they shall re-register their names and take the examination in the texts/revised regulations/syllabus of the paper prescribed for the subsequent batch of candidates, in force at the time of their reappearance. In the event of removal of that paper consequent to change of regulation and/or curriculum after N+2 years period, the candidate shall have to take up an equivalent paper in the revised syllabus as suggested by the Chairman, Board of Studies concerned.

12. BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted 'only once' immediately after completion of the program of study.

13. DETENTION AND RE-ADMISSION

If a student fails to meet the minimum attendance requirement or minimum standards for academic progression, the concerned academic head will recommend for detention and it will be notified by the concerned Dean of the School. The students who are detained in the current semester will not be allowed to register for the next semester and they have to repeat the same semester.

The candidates who are detained or availed academic break or suspended in the previous semester/academic year and want to continue their study shall apply for re-admission to the university. The candidates shall request for re-admission to the respective Head of the Department, with details viz., Full Name, Registration Number, Department, School, Fee payment particulars with proofs and reasons for discontinuations. The concerned academic head will forward it to the Registrar with specific comments. The Registrar will notify

the decision of re-admission which shall include the prescribed fee particulars, semester/ year into which readmission is granted and additional courses to be completed by the student (if any). The candidates should apply for re-admission in advance, that is before the commencement of the semester.

14. GROOMING AND ATTIRE FOR STUDENTS

Grooming and Etiquette is of great significance in the dynamic of shaping one's Personality. The Apollo University stands by a *Code of Grooming, Attire and Etiquette* that promotes a professional standard: Academic Day; Campus Placements and Non-Academic Hours on Campus.

The Dress Code to be in compliance on academic premises while attending: Formal Functions of the Institution / Lectures / Practicals / Dining Area / Library / Labs / Office Areas.

Students shall follow appropriate attire during Academic and Non-Academic hours on the campus. Students shall wear clean, neat, pressed and presentable clothing, and command respect by dressing in accordance with responsible personal norms. Students shall always wear The Apollo University ID Card with the Lanyard.

Grooming and Formal Wear - Boys:

Formal Shirts / T-Shirts with a Collar should preferably be tucked in with a Formal pair of Pants Shoes and Socks to complete the Formal Attire. Personal Hygiene should be followed and Hair should be well groomed.

Smart Casuals for Boys:

Long Kurtas / Formals / Semi-Formal Shirts with Jeans.

Grooming and Formal Wear - Girls: Sarees / Salwar Suits / Leggings or Jeggings with Long Kurtis / Long Frocks / Long Skirts / Palazzos. Complement the outfit with proper footwear. Personal Hygiene should be followed and Hair should be well groomed.

Smart Casuals for Girls:

Jeans with long Kurtis / Long Skirts / Long Frocks.

Attire for Non-Academic Hours On Campus:

The students should be neatly attired during Non-Academic Hours on Campus.

Dress Code for Boys:

Jeans / Track Suits / T-Shirts / Trousers / Shirts.

Dress Code for Girls:

Jeans / T-Shirts or Blouses / Salwar Suits / Palazzos / Leggings or Jeggings with Long Tops / Sarees / Long Skirts / Track Suits.

DO'S AND DO'NTS FOR BOYS AND GIRL STUDENTS OF THE UNIVERSITY:

- To wear modest clothing that reflects the essence of good personal grooming standards.
- To refrain from wearing Sleeveless Clothing; Shorts; Short Tops, etc.,

PLEASE NOTE: The decision as to what constitutes Appropriate Attire vests with the Authorities of The Apollo University.

15. ELIGIBILITY FOR AWARD OF THE DEGREE

The undergraduate degree will be of 4-years/ 3-years(Lateral Entry) of duration. A student shall be declared as eligible for the award of the degree if the candidate has successfully secured the minimum number of required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

After successful completion of the program, a provisional certificate cum memorandum of grades (PCMG) will be issued to the students. The PCMG includes the secured grades and class achieved in chosen program and specialization if any, along with grades and CGPA secured by the student. The original degree will be presented in the subsequent convocation.

16. DISCRETION POWER

Not with-standing anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

ANNEXURE 1

ELIGIBILTY FOR QUALIFYING EXAM FOR UNDER GRADUATE PROGRAMS

Program Type	**Program Name**	**Eligibility**
Bachelor's	B.Sc. Medical Laboratory Technology	Passed with at least 45% (40% in case the candidates belong to reserved category) marks with Botany, Zoology, Physics and Chemistry or Inter vocational with Bridge course of Biological and Physical Sciences (or) APOSS with Biological Sciences and Physical Sciences from a recognized board or other equivalent board or Intermediate and attain 17 Years as on 31st December of Calendar Year.

ANNEXURE 2

PROGRAMS OFFERED BY THE DIVISION OF ALLIED HEALTH SCIENCES

FROM THE ACADEMIC YEAR 2021-22

Sl. No.	Program	Expanded	Level	Minimum Duration in Years (N)
1.	B.Sc. PAT	B.Sc. Physician Assistant	Bachelor's	4
2.	B.Sc. MLT	B.Sc. Medical Lab Technology	Bachelor's	4
3.	B.Sc. IMT	B.Sc. Imaging Technology	Bachelor's	4
4.	B.Sc. AOTT	B.Sc. Anaesthesiology and Operation Technology	Bachelor's	4
5.	B.Sc. RDT	B.Sc. Renal Dialysis Technology	Bachelor's	4
6.	B.Sc. RTT	B.Sc. Respiratory Therapy Technology	Bachelor's	4
7.	B.Sc. EMT	B.Sc. Emergency Medical Technology	Bachelor's	4
8.	BOPT	Bachelors in optometry	Bachelor's	4
9.	BPT	Bachelor of Physiotherapy	Bachelor's	4.5

Program Structure

The various courses of the AHS Program are categorized in terms of their academic affinity or their functional objectives as Core Courses, Elective Courses.

Core courses: Core courses are compulsory sets of papers. (They are in accordance with the syllabi of the University)

Electives courses: There will be a specified number of elective courses classified as Open Electives. The students are offered a pool of different elective courses from which they will choose the course/courses as per their interest and credit requirements. A faculty advisor may be appointed to guide the students to opt for the elective courses that are relevant to the subject in which the student is registered for the degree.

I - Semester

Induction Programme						
Course Code	**Course Name**	**Periods per week**			**Credits**	**Hours per week**
		L	**T**	**P**		
AHSJ1301	Anatomy	3	1	2	5	6
AHSJ1302	Physiology	3	1	2	5	6
AHSJ1303	Biochemistry	3	1	2	5	6
TAUT1101	University Core – I (Communicative English)	3	0	0	3	3
TAUT1201	University Elective - I	3	0	0	3	3
--	Mentoring	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra- curricular activities	0	0	0	0	2
--	Co-curricular activity	0	0	0	0	2
--	Self-Learning	0	0	0	0	2
	Seminar	0	0	0	0	2
TOTAL		**15**	**3**	**6**	**21**	**36**

II - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
AHSJ1304	Microbiology	3	1	2	5	6
AHSJ1305	Pathology	3	1	2	5	6
AHSJ1306	Pharmacology	3	1	2	5	6
TAUT1102	University Core - II (Environment Studies)	3	0	0	3	3
TAUT1202	University Elective - II	3	0	0	3	3
MLTT1501	Programme Core (Fundamentals of Medical Laboratory Technology)	3	0	0	3	3
--	Mentoring	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra-curricular activities	0	0	0	0	2
--	Self - Learning	0	0	0	0	2
--	Seminar	0	0	0	0	1
TOTAL		**21**	**3**	**6**	**27**	**36**

III - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
MLTT2501	General Bacteriology and Immunology	3	1	0	4	4
MLTL2501	General Bacteriology and Immunology - Practical	0	0	4	2	4
MLTT2502	Metabolism of Biochemistry	3	1	0	4	4
MLTL2502	Metabolism of Biochemistry – Practical	0	0	4	2	4
MLTT2503	Histopathology, Cytopathology & Hematopathology	3	1	0	4	4
MLTL2503	Histopathology, Cytopathology & Hematopathology – Practical	0	0	4	2	4
TAUT2101	Health and Wellness	3	0	0	3	3
TAUT2201	University Elective - III	3	0	0	3	3
--	Mentoring	0	0	0	0	1
--	Extra-curricular activities	0	0	0	0	2
--	Library	0	0	0	0	1
--	Seminar	0	0	0	0	1
--	Self-Learning	0	0	0	0	1
TOTAL		**15**	**3**	**12**	**24**	**36**

IV - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
MLTT2504	Systemic Bacteriology	3	1	0	4	4
MLTL2504	Systemic Bacteriology - Practical	0	0	8	4	8
MLTT2505	Analytical Techniques and Instrumentation - I	3	1	0	4	4
MLTL2505	Analytical Techniques and Instrumentation - I Practical	0	0	7	4	7
MLTT2506	Cytopathology - 2 and Mounting of Museum Specimens	3	1	0	4	4
MLTL2506	Cytopathology - 2 and Mounting of Museum Specimens – Practical	0	0	7	4	7
--	Mentoring	0	0	0	0	1
--	Extra-curricular activities	0	0	0	0	1
TOTAL		**9**	**3**	**22**	**24**	**36**

V - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
MLTT3501	Systemic Virology and Mycology	3	1	0	4	4
MLTL3501	Systemic Virology and Mycology - Practical	0	0	7	4	7
MLTT3502	Analytical Techniques and Instrumentation – II	3	1	0	3	6
MLTL3502	Analytical Techniques and Instrumentation – II Practical	0	0	6	3	6
MLTT3503	Histopathology, Cytopathology, Hematopathology and Museum Techniques	3	1	0	4	4
MLTL3503	Histopathology, Cytopathology Hematopathology and Museum Techniques - Practical	0	0	6	3	6
MLTT3601a MLTT3601b MLTT3601c	1. Artificial Intelligence in Microbiology* 2. Medical Laboratory Management and Quality Control* 3. Medical Law and Ethics*	3	0	0	3	3
TOTAL		**12**	**3**	**20**	**4**	**36**

VI - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
MLTT3504	Systemic Parasitology	3	1	0	4	4
MLTL3504	Systemic Parasitology - Practical	0	0	8	4	8
MLTT3505	Analytical Techniques and Instrumentation – III	3	1	0	4	4
MLTL3505	Analytical Techniques and Instrumentation - III Practical	0	0	6	3	6
MLTT3506	Practical Histopathology, Transfusion medicine and Hematopathology	3	1	0	4	4
MLTL3506	Histopathology, Transfusion medicine and Hematopathology Practical	0	0	6	3	6
MLTT3602a MLTT3602b MLTT3602c	1. Advances in Diagnostic Microbiology 2. Preventive and Social Medicine 3. Research Methodology	3	0	0	3	3
--	Mentoring	0	0	0	0	1
TOTAL		**12**	**3**	**20**	**25**	**36**

VII & VIII Semester

Course Code	Course Name	Periods per week			Credits	Hours per Semester
		L	T	P		
MLTI4501	Internship-I	0	0	**48**	**25**	**1104**
TOTAL				**48**	**25**	**1104**

Course Code	Course Name	Periods per week			Credits	Hours per Semester
		L	T	P		

MLTI4502	Internship-II	0	0	**48**	**25**	**1104**
MLTP4501	Project	0	0	**8**	**6**	**180**
TOTAL				**51**	**31**	**1284**

Internship (Practical training:1500 Hours)		
Section	**Topics**	**Hours**
General Microbiology	Media Preparation, Sterilization Techniques, Aseptic Techniques	**80**
Clinical Microbiology	Sample Collection and Handling, Diagnostic Microbiology, Bacteriology, Antimicrobial Susceptibility Testing	**180**
Serology and Immunology	Serological Tests, Immunoassays, Flow Cytometry, Allergy Testing	**120**
Virology, Mycology, and Parasitology	Virus Culture, Identification, and Quantification; Fungal Culture and Identification; Parasite Identification and Life Cycle Studies	**120**
General Biochemistry	Buffer Preparation, Spectrophotometry	**80**
Protein Biochemistry	Protein Extraction and Purification, Protein Quantification, Electrophoresis, Western Blotting	**120**
Analytical Biochemistry	Chromatography, Mass Spectrometry	**120**
Enzymology	Enzyme Assays, Kinetics, Inhibition Studies	**80**
Nucleic Acid Biochemistry	DNA/RNA Extraction, PCR, Gel Electrophoresis, ELISA	**120**
Lipid Biochemistry	Lipid Extraction and Analysis, Lipid Quantification	**80**
Carbohydrate Biochemistry	Sugar Analysis, Glycoprotein Analysis	**80**
Clinical Biochemistry	Blood and Urine Analysis, Hormone and Drug Assays	**80**
Histopathology	Tissue Processing, Microscopic Examination, Special Stains, Immunohistochemistry	**100**
Cytopathology	Sample Collection and Preparation, Staining and Examination, Diagnostic Cytology	**100**
Hematology and Blood Bank	Blood Sample Analysis, Peripheral Blood Smears, Bone Marrow Examination, Coagulation Studies, Blood Typing, Crossmatching, Blood Storage, and Transfusion Protocols	**120**
Total		**1500**

Assessment and Evaluation

The evaluation will be continuous, and the weight ages of various components are given in Table 1 (For Theory courses) and Table 2 (for Practical Courses).

For Theory Courses	
Sessional Tests (STs)/Midterm exams	40
End Term Examination	60
Total	**100**

Table 1: Evaluation Components for Theory Course

There are three Midterm exams for all theory papers, the average of the best two is considered. The policy on the evaluation component – 'Quizzes / Tutorials / Assignments' is decided by the course coordinator and HOD and is announced separately for each course. The End Term examination for practical courses includes the conduct of experiments and viva voce.

For Internship	
EXTERNAL COMPONENTS: 60 marks	
Performance	10
Logbook	10
Attendance	10
Discipline	10
Project	20
INTERNAL COMPONENTS: 40 marks	
Demonstration and Viva	40
Total	**100**

Table 3: Evaluation Components for Internship

Clinical skills / Practical	
EXTERNAL COMPONENTS: 20 marks	
Presentation	10
Viva	10
INTERNAL COMPONENTS: 80 marks	
Continuous Evaluation I	20
Continuous Evaluation II	20
Continuous Evaluation III	20
Logbook	20
Total	**100**

Table 4: Evaluation Components for Clinical Skills

FIRST YEAR – FIRST SEMESTER

PROGRAM CORE

3 Week Induction Programme						
Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
AHSJ1301	Anatomy	3	1	2	5	6
AHSJ1302	Physiology	3	1	2	5	6
AHSJ1303	Biochemistry	3	1	2	5	6
TAUT1101	University Core -I (Communicative English)	3	0	0	3	3
	University Elective I	3	0	0	3	3
--	Mentoring	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra-curricular activities	0	0	0	0	2
--	Co-curricular activity	0	0	0	0	2
--	Self- Learning	0	0	0	0	2
	Seminar	0	0	0	0	2
TOTAL		15	3	6	21	36

University Elective – I
Semester – I

S. No	Name of the Course	Host Department
1	Basics of Physiotherapy	School of Health Sciences – Physiotherapy
2	Biostatistics	School of Health Sciences – BMS & GMB
3	Constitution of India	School of Social Sciences
4	Ethical Hacking	School of Technology - CSE
5	Fundamentals of Computers	School of Technology - CSE
6	Gender and Development	School of Social Sciences
7	Leadership Development	School of Management
8	Mathematical Thinking	School of Technology
9	Nursing	Apollo Institute of Nursing
10	One Health	School of Health Sciences – PH
11	Basic emergency care and life support skills	School of Health Sciences – AHS
12	Basics of Health Management	School of Health Sciences – AHS
13	Entrepreneurship	School of Management
14	Managerial Economics	School of Management
15	Organic Farming	School of Health Sciences – BMS & GMB
16	Personality Development	School of Health Sciences – Psychology
17	Social Entrepreneurship	School of Management

1st Year: I Semester

AHSJ1301	**ANATOMY**	**L**	**T**	**P**	**C**
		3	**1**	**2**	**5**

Course Description:

This course will cover anatomy with special emphasis on general anatomy including anatomical position, anatomical planes, cell structure, tissues and upper and lower limbs focussing on important muscles, arteries, veins, and nerves which are of significant clinical importance. This course also covers important and relevant anatomical knowledge of all systems namely nervous, cardiovascular, respiratory, gastrointestinal, reproductive, and excretory systems.

This course also covers practical teaching of osteology, gross anatomy of important viscera, radiology and histology.

Course Objectives:

Students undergoing this course are expected to:

1. Understand and learn the origin, insertion, action, and nerve supply of clinically important muscles.
2. Understand and learn the origin, course, branches and clinical aspects of important vessels and nerves.
3. Explain the location, external features, relations, blood supply, clinical importance of organs of nervous, cardiovascular, respiratory, gastro-intestinal, reproductive, endocrine and excretory systems.

THEORY **Total: 60 Hrs**

UNIT-I **12Hrs**

INTRODUCTION

- Introduction to anatomy
- Define Anatomy and list its sub-divisions.
- Describe the Anatomical position.

General Histology

- Describe the human cell and its organelle.
- Describe the types of cell division and give examples.
- List out the types of tissues and describe their basic structure.
- Briefly describe the types of connective tissue including specialized connective tissue
- Describe the types and functions of epithelia.

UPPER LIMB

- Name the important bones, muscles, blood vessels & nerves of the upper limb.
- Briefly describe the movements of joints and the nerve supply and actions of the important muscle groups of the upper limb
- Describe the location and course of the major blood vessels & nerves of the upper limb.

UNIT-II **12 Hrs**

LOWER LIMB

- Name the important bones, muscles, blood vessels & nerves of the lower limb
- Briefly describe the movements of joints, nerve supply and actions of the important muscle groups of the lower limb
- Describe the location and course of the major blood vessels & nerves of the lower limb

RESPIRATORY SYSTEM

- Name the parts of the respiratory system.
- Briefly describe the pleura and its disposition
- Describe the external features of the lungs and their relations.
- Name the bronchopulmonary segments in each lung and explain their significance.
- Briefly describe the mechanism of respiration

UNIT-III

CARDIOVASCULAR SYSTEM **12 Hrs**

- Describe the important external and internal features of the heart.
- Briefly describe the blood supply of the heart
- Describe the circulation of blood through the heart and types of circulation.
- Describe the aorta and its branches.
- List out the major veins that join into the superior and inferior vena cavae.
- Briefly describe the lymphatic system and its function

NERVOUS SYSTEM

- Classify nervous system.
- Describe briefly the external and internal features of the spinal cord, its coverings and blood supply.
- Describe briefly the external and internal features of the brainstem and the functional significance of the tracts and nuclei seen in the brainstem.
- Briefly describe the cerebellum and its peduncles
- Describe the cerebrum in brief and its lobes and functional areas of importance.
- Briefly describe the circulation of cerebrospinal fluid

UNIT-IV **12 Hrs**

ENDOCRINE SYSTEM

- Name the endocrine glands and the hormones secreted by each.
- Briefly describe the anatomy and physiology of the pituitary, thyroid, parathyroid, Adrenal, and pancreas.

REPRODUCTIVE SYSTEM

- Describe briefly the male reproductive system.
- Describe briefly the female reproductive system.
- List out the hormones released by the organs in the reproductive system**.**

EXCRETORY SYSTEM

- Describe briefly the excretory system.

UNIT-V **12 Hrs**

GASTROINTESTINAL SYSTEM

- Briefly describe the extent, important anatomical features, and relations of various parts of the gastrointestinal tract.
- Describe the important anatomical features, surface anatomy, relations and functions, and blood supply of the liver.
- Briefly describe the parts, important features and functions of the oesophagus, stomach, duodenum, small intestine, and large intestine.
- Describe briefly the important anatomical features, position and relations and functions of pancreas and spleen.
- Briefly describe the blood supply of the gastrointestinal system.

Course outcomes:

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

- Explain the origin insertion, action, nerve supply, and clinical importance of muscles.
- Understand and learn the origin, course, branches and clinical aspects of important vessels and nerves.
- Explain the location, external features, relations, blood supply, and clinical importance of various organs of nervous, cardiovascular, respiratory, gastro-intestinal, reproductive, and excretory systems.

PRACTICALS **Total: 30 Hrs**

Course Objective: The course will cover Anatomy with special emphasis on osteology, histology, demonstration of viscera, radiology.

The assessment of the students will be undertaken with the help of following exercises.

- Spotters
- Viva

Textbooks:

1. Manipal manual of Human anatomy
2. Human anatomy & Physiology for Nursing – Mahindra Kumar Anand & Meena Verma
3. Understanding Human Anatomy & physiology – Willian Davis (McGraw Hill)
4. Anatomy & physiology – Kaarna Muni Shekhar
5. Textbook of Anatomy – Chaurasia
6. Textbook of Anatomy – TS Ranganathan Human Anatomy – Fattana.

Reference Books:

Textbook of anatomy-Vishram Singh

ALLIED HEALTH SCIENCES
1st Year: I Semester

AHSJ1302	**PHYSIOLOGY**	**L**	**T**	**P**	**C**
		3	**1**	**2**	**5**

Course Description:

The goal of this course is to help students in understanding functions, regulation, and integration of organ systems of the human body.

Course Objectives:

- Describe the concept of homeostasis.
- Interpret the structure of the cell membrane and describe the transport mechanisms for solute and water across the cell membrane. Explain the basis of membrane potential.
- Describe the structure and functional organization of the human nervous system and its subdivisions. Discuss the role of nervous system in homeostasis.
- Understand how heart and blood vessels work to maintain a constant delivery of blood flow (oxygenated) to all the tissues and simultaneously how the blood is returned (deoxygenated/ venous blood) to the heart. Explain how cardiovascular system adjust its activity to meet the demands placed by the body during activities of daily life (E.g., exercise)
- Describe the basic anatomy and functions of the pulmonary system.
- Explain the role of kidney in blood pressure, electrolyte, and fluid homeostasis.
- Elaborate on how the structure of gastrointestinal tract suited for digestion and absorption. Discuss the mechanism of digestion and absorption at various levels of gastrointestinal tract.
- Describe how endocrine organs are involved in regulation of growth, metabolism, fluid and electrolyte balance and reproduction.

THEORY **Total: 60 Hrs**

UNIT-I **10 Hrs**

1. General Physiology (Cell Physiology)

- Homeostasis
- Cell structure and functions of cell with special emphasis on characteristics of cell membranes, Transport mechanisms across cell membrane.
- Body Fluid Compartments (volume, composition, and units to measure solute concentration).

2. Nerve-Muscle Physiology

- Neuron (structure and function), Classification of neurons, Neuroglia, Type of nerve fibers, Resting membrane potential and Action potential.

- Neuromuscular Junction (skeletal muscle) and Neuromuscular blocking drugs
- Classification and functions and structure of muscles, Excitation contraction coupling, Mechanism of muscle contraction
- Differences between skeletal, smooth, and cardiac muscle.
- Applied physiology: Nerve injury, Myasthenia gravis, Neuromuscular junction blockers, Muscular dystrophy.

3. Blood (Hematology)

- Composition of blood, functions of cellular (RBC, WBC, and platelets) and non-cellular (plasma and plasma proteins) components of blood.
- RBC (Erythrocyte): Erythropoiesis and factors affecting it, Normal count, and variations. Hemoglobin: Functions and recycling of hemoglobin, Jaundice, Anemia.
- WBC: Classification, morphology, site of production, functions, normal and differential count, and variations. Immunity.
- Platelets: Origin, normal count, and functions (role in hemostasis).
- Hemostasis: Clotting factors and their role in hemostasis. Disorders of Hemostasis.
- Blood groups: ABO & Rh systems, Erythroblastosis fetalis, Hazards of mismatched blood transfusion
- Reticuloendothelial system

UNIT-II **13 Hrs**

1. Nervous system (Central Nervous system)

- Parts (gross connections)
- **Cerebral hemisphere**: parts, corpus callosum, cerebral cortex, and functions of frontal, parietal, temporal, and occipital lobes of the cerebrum.
- Connections between motor cortex and subcortical structures and spinal cord (descending tracts). Connections between spinal cord and thalamus- somatosensory cortex of parietal lobe (ascending tracts).
- Upper and lower motor neurons
- Descending and ascending tracts (origin, location, course, and termination)
- **Subcortical structures**

Basal ganglia, Thalamus, Hypothalamus, and Limbic system. Nuclei of subcortical structures, its connections with various parts of the brain and its functions.

- **Brain stem**: (Midbrain, Pons, and Medulla oblongata)

Nuclei, connections, and its functions

- **Cerebellum**

Physiological anatomy: lobes, cerebella cortex, connections (afferent and efferent), functions and applied aspects.

- Reticular formation and its functions
- Sleep
- **Spinal cord:** parts of gray matter and constituents of white matter. Applied physiology.

Peripheral Nervous System

- Divisions and constituents of the peripheral nervous system

- Functions of cranial and spinal nerves
- Physiological anatomy of somatic nervous system and its functions
- Physiological anatomy of autonomic nervous system (sympathetic and parasympathetic) and its functions.

2. Special senses

- **Vision** –Functional anatomy of eye, visual pathway. Applied physiology: lesions along visual pathway and its effect. Refractive errors.
- **Hearing**– Physiological anatomy of ear, Mechanism of hearing, and auditory pathway. Applied physiology: deafness.
- **Olfaction** –receptors and pathway, function, and its applied physiology
- **Gustation**-modalities, receptor, function, taste pathway, and its applied physiology

UNIT- III **14 Hrs**

1. Cardiovascular system

- Physiological anatomy of the heart, autonomic innervation, and its action on the heart, pulmonary and systemic circulation
- Properties of cardiac muscle
- Conducting system of the heart
- Electrocardiogram
- Cardiac cycle, Heart sounds.
- Vascular system (branching), hemodynamics, factors influencing resistance to the blood flow.
- Cardiac output: definition, factors regulating it and measurement of cardiac output.
- Blood pressure: Definition, components, determinants of blood pressure and factors regulating it.
- Lymphatic system and its functions
- Pulse
- Applied aspects of cardiovascular physiology: myocardial infarction, heart failure, shock, and others
- Cardiovascular changes during exercise

2. Respiratory System

- Physiological anatomy of the respiratory tract, conducting and respiratory zone of the respiratory tract, pleural and pleural cavity, mechanics of respiration, changes in intrapleural and intrapulmonary pressures during respiratory cycle.
- Compliance and factors affecting it (surface tension and surfactant), respiratory distress syndrome.
- Lung volumes and capacities
- Respiratory membrane, partial pressure of gases, transport of O_2 and CO_2, Oxyhemoglobin dissociation curve.
- Regulation of respiration (Chemical and Neural)
- Hypoxia, dyspnea, apnea, asphyxia, and cyanosis
- Artificial respiration

UNIT-IV **13 Hrs**

1.Digestive System

- Introduction to Gastrointestinal system and Physiological anatomy of the wall of Gastrointestinal tract
- **Salivary glands** and its function, mastication, pharynx, and Deglutition
- **Stomach:** physiological anatomy, composition of Gastric juice (HCL secretion), its functions and its regulation.
- Vomiting reflex.
- **Liver and gall bladder**: Bile composition and its functions, and other functions of the liver, functions of the gall bladder. Enterohepatic circulation
- **Pancreas:** Pancreatic juice composition, its functions and regulation of its release.
- **Small intestine:** Succus entericus composition, functions, and regulation of its release. Small intestinal motility and its functions.
- **Large intestine:** function, movements, and Defecation reflex
- Digestion and absorption of carbohydrates, fats, and proteins.

2.Renal System

- Physiological anatomy & functions of the kidney, blood supply and special features of blood flow to the kidney. Structure and types of nephrons
- Histology of the renal corpuscle: Juxtaglomerular apparatus.
- Mechanisms of formation of urine: Glomerular filtration rate (GFR), Tubular reabsorption (Special emphasis on reabsorption of water, Na+, Glucose, HC03- and Ca2+) and tubular secretion (special emphasis on secretion of K+ and H+). Renal handling of urea, Renal threshold, and Tubular maximum.
- GFR: Starling forces acting across the glomerular capillaries and factors affecting GFR
- Concentration of urine: role of counter-current multiplier and counter-current exchanger
- Role of kidney in Regulation of blood pressure and pH
- Diuresis, diuretics, renal clearance. Renal function tests.
- Artificial kidney (Dialysis)
- Skin: Physiological anatomy of the skin and its role in temperature regulation.

UNIT-V **10 Hrs**

1. Endocrine System

- Physiological anatomy & functions of the kidney, blood supply and special features of blood flow to the kidney. Structure and types of nephrons
- Histology of the renal corpuscle: Juxtaglomerular apparatus.
- Mechanisms of formation of urine: Glomerular filtration rate (GFR), Tubular reabsorption (Special emphasis on reabsorption of water, Na+, Glucose, HC03- and Ca2+) and tubular secretion (special emphasis on secretion of K+ and H+). Renal handling of urea, Renal threshold, and Tubular maximum.

- GFR: Starling forces acting across the glomerular capillaries and factors affecting GFR
- Concentration of urine: role of counter-current multiplier and counter-current exchanger
- Role of kidney in Regulation of blood pressure and pH
- Diuresis, diuretics, renal clearance. Renal function tests.
- Artificial kidney (Dialysis)
- Skin: Physiological anatomy of the skin and its role in temperature regulation.

2. Reproductive system

- Introduction to reproductive system, sex differentiation, and Puberty.
- **Male reproductive system**, physiological anatomy of the testis and its functions, functions of testosterone, Spermatogenesis, and its regulation.
- **Female reproductive system**; physiological anatomy of ovaries and uterus.
- Functions of ovaries; Oogenesis and ovarian cycle, functions of Estrogen and Progesterone, and menstrual cycle.
- Physiological changes during pregnancy, pregnancy tests, parturition & lactation.
- Male & Female contraceptive methods.

Course Outcome:

At the end of the course, students should

- have thorough knowledge and appreciation of the concepts in Human physiology
- understand the role of all organ systems in homeostasis
- understand how the organ systems work in unison to bring out integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail
- be able to perform, analyse and report on experiments and observations in physiology
- be able to apply their knowledge in their respective branches of Allied Health Sciences

PRACTICALS **Total: 30 Hrs**

HEMATOLOGY

- Microscope
- Estimation of Hemoglobin
- Estimation of bleeding time and clotting time
- Measurement of ESR – demo
- Estimation of PCV – demo
- Perform RBC count of given blood sample.
- Perform WBC count of given blood sample.
- Perform a Differential Leucocyte Count.
- Calculation of blood indices

CLINICALS

A. Cardiovascular system

- Examination of radial pulse
- Measurement of blood pressure
- Recording of ECG- demo
- Measure of weight and height and calculate body mass index
- Demonstrate JVP, apex beat, percussion of cardiac borders, auscultation of heart sounds.

B. Respiratory system

- Measurement of respiratory rate and temperature
- Examination of respiratory system and temperature
- Spirometry demo

C. Nervous system

- Examination of cranial nerves
- Motor system examination
- Examination of reflexes
- Examination of the sensory system

D. Special senses

- Eye: Tests for vision (Acuity and colour perception)
- Ear: Hearing tests

Textbooks:

1. HH Sudhakar D Venkatesh "Basics of Medial Physiology", 5th edition, Wolters Kluwer,2023.
2. K Sembulingam, Prema Sembulingam, "Essentials of Physiology for Paramedical Students" JAYPEE, 2021.

Reference Books:

1. John E Hall and Michael E. Hall, Guyton & Hall, "Textbook of Medical Physiology" 14th edition, 2020
2. Eric P. Widmaier, Hershel Raff, and Kevin T. Strang "Vanders Human Physiology" 15TH edition, 2018.

ALLIED HEALTH SCIENCES
1st Year: I Semester

AHSJ1303	**BIOCHEMISTRY**	**L**	**T**	**P**	**C**
		3	**1**	**2**	**5**

Course Description:

This course introduces students to the structure and function of essential biomolecules, which are the organic compounds that constitute the various components of living cells. The course covers the biochemical reactions that facilitate cellular growth, maintenance, reproduction, and energy utilization and storage.

Course Objectives:

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

- Understand the structure and functions of the cell membrane and organelles.
- Comprehend the chemistry of carbohydrates, lipids, proteins, and nucleic acids.
- Explain enzyme actions, mechanisms, inhibition, and clinical enzymology.
- Grasp the significance of nutrition, including vitamins and minerals.
- Describe the structure and functions of immunoglobulins and hemoglobin.

THEORY **Total: 60 Hrs**

UNIT-I **4 Hrs**

Cell and Membrane: Cell organelles and their functions, membrane structure, transport mechanisms across membranes, ionophores, membrane proteins, and transporters.

UNIT- II: **15 Hrs**

Chemistry of Biomolecules

- **Chemistry of Carbohydrates:** Definition, classification, important monosaccharides, stereoisomers, anomers, mutarotation, and reactions of monosaccharides (tautomerization, reduction, dehydration, osazone formation). Important disaccharides and polysaccharides.
- **Chemistry of Lipids:** Definition, classification, nature of fatty acids, triacylglycerol, saponification, iodine number, rancidity, antioxidants, complex lipids, steroids, and cholesterol functions.
- **Chemistry of Amino Acids, Peptides, and Proteins:** Definition, classification, peptide bonds, biologically important peptides, essential and non-essential amino acids, protein structure (primary, secondary, tertiary, quaternary), precipitation, denaturation, coagulation, and color reactions of amino acids.
- **Chemistry of Nucleic Acids:** Nitrogenous bases, nucleosides, nucleotides, DNA, genes, and types of RNA involved in protein synthesis.

UNIT-III: **5 Hrs**

Enzymes: Definition, classification, factors affecting enzyme activity, mechanism of action, coenzymes, proenzymes, isoenzymes, measurement units, competitive and non-competitive inhibitors, and clinical enzymology with normal values.

UNIT- IV: **12 Hrs**

Nutrition and Vitamins

- **Nutrition:** Calorific values of food, basal metabolic rate, specific dynamic action, energy requirements, nutritional importance of carbohydrates, lipids, proteins, nitrogen balance, protein supplementation, Kwashiorkor, Marasmus, and Recommended Dietary Allowance (RDA).
- **Vitamins:** Overview of chemistry, sources, requirements, biochemical functions, deficiency symptoms of vitamins A, D, E, K, B-complex (thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, B-12), and Vitamin C.
- **Mineral Metabolism:** Classification of macro and micro elements, including sodium, potassium, calcium, phosphorus, iron, iodine, magnesium, copper, zinc, fluoride, manganese, selenium, and molybdenum.

UNIT -V: **4 Hrs**

Immunology and Hemoglobin

- **Immunology:** Definitions of antigens and antibodies, structure and functions of antibodies.
- **Hemoglobin:** Structure and functions of hemoglobin, its derivatives, degradation process, and jaundice.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Describe the structures and functions of cell membranes and organelles.
- Understand and explain the chemistry and classifications of major biomolecules.
- Classify enzymes and explain their mechanisms, inhibition types, and clinical relevance.
- Comprehend the basics of nutrition, including sources, recommended dietary allowances (RDA), functions, and deficiency symptoms of vitamins and minerals.
- Explain the structure and functions of immunoglobulins and hemoglobin.

Textbooks: latest editions

1. Concise Textbook of Biochemistry for Paramedical Students (2nd Edition, 2023) by DM Vasudevan

2. A Textbook on Biochemistry for Paramedical Students (2022) by Dr. Kiran Dahiya

Reference Book:

1. Textbook of Biochemistry for Medical Students (10th Edition, 2023) by DM Vasudevan

FIRST YEAR – SECOND SEMESTER

II - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
AHSJ1304	Microbiology	3	1	2	5	6
AHSJ1305	Pathology	3	1	2	5	6
AHSJ1306	Pharmacology	3	1	2	5	6
TAUT1102	University Core-II (Environmental studies)	3	0	0	3	3
--	University Elective-II	3	0	0	3	3
EMTT1501	Fundamentals of EMT	3	0	0	3	3
--	Mentoring	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra-curricular activities	0	0	0	0	2
--	Self-Learning	0	0	0	0	2
--	Seminar	0	0	0	0	1
TOTAL		**18**	**3**	**6**	**24**	**36**

ALLIED HEALTH SCIENCES

1st Year: 2nd Semester

AHSJ1304	**MICROBIOLOGY**	**L T P C**
		3 1 2 5

Course Description:

This course will cover on general properties of pathogenic bacteria, viruses, fungi and parasites along with immune mechanisms, its response, methods of sterilization and disinfection, healthcare associated infections and hospital infection control practices. It helps the student to understand the natural history of infectious diseases to deal with etiology, pathogenesis, clinical features, laboratory diagnosis, treatment and control of infections in the community including immunoprophylaxis.

Course Objectives:

Students undergoing the course shall be expected to:

- Learn the general properties, structure and physiological aspects of bacteria and identification of bacteria.
- Learn about infection, immunity, various antigen-antibody reactions, immune mechanisms and hypersensitivity reactions and various infection control practices.
- Learn about pathogenesis, laboratory diagnosis and prophylactic measures of various bacterial infections.
- Learn about general properties of viruses and fungi and morphology, pathogenesis, laboratory diagnosis and prophylactic measures of various viral and fungal infections.
- Learn about classification of parasites and their morphological forms, life cycle, pathogenesis, laboratory diagnosis and prophylactic measures of various parasitic infections.

THEORY **Total: 60 Hrs**

UNIT-I **10 Hrs**

INTRODUCTION TO MEDICAL MICROBIOLOGY

- Importance of Medical Microbiology
- Historical aspects

GENERAL PROPERTIES & PHYSIOLOGICAL ASPECTS OF BACTERIA

- Structure of bacteria and its appendages like capsule, flagella, pili and spore
- Classification based on morphology, arrangement and motility
- Microscopy & Staining techniques
- Bacterial Growth Curve, Nutritional requirements of bacteria

BACTERIAL IDENTIFICATION METHODS

- Culture media, Culture Methods
- Specimen collection and transport to the laboratory

- Laboratory methods of Identification of Bacteria
- Antibiotic Sensitivity testing – Diffusion and Dilution methods

UNIT-II **12 Hrs**

INFECTION CONTROL PRACTICES

Infection – Definition, types and sources of infection, mode of transmission, types of infectious diseases, microbial pathogenicity

- Sterilization, Disinfection and Asepsis
- Standard Safety Precautions
- Biomedical Waste Management
- Hospital acquired infections, mode of spread, types and predisposing factors, investigation and surveillance

IMMUNOLOGY

Immunity – Definitions, terminology, Innate, acquired and herd immunity

- Antigen & Antibody
- Antigen-Antibody Reactions – Precipitation reactions, Agglutination reactions, ELISA, IFA
- Immune response
- Hypersensitivity - Definition and Classification and Type I, II, III, IV types of hypersensitivity
- Immunoprophylaxis – Immunization schedule, vaccines, storage & handling, hazards of immunization

UNIT-III **16 Hrs**

PATHOGENIC BACTERIA– Morphology, pathogenicity, laboratory diagnosis and prophylaxis of the following organisms

- **Gram Positive Cocci:** Staphylococci, Streptococci & Pneumococci
- **Gram Negative Cocci:** Meningococci, Gonococci
- **Gram Positive Bacilli:** Corynebacterium diphtheriae, Clostridium perfringens, Clostridium tetani, Clostridium botulinum, Bacillus anthracis, Bacillus cereus
- **Gram Negative Bacilli:** Escherichia coli, Klebsiella, Proteus, Salmonella, Shigella, Vibrio, Bordetella, Hemophilus
- **Acid Fast bacilli:** Mycobacterium tuberculosis, Mycobacterium leprae
- **Spirochaetes:** Treponema, Borrelia, Leptospira
- Ricketssiae

UNIT-IV **12 Hrs**

GENERAL VIROLOGY

- **General Properties of Viruses** – Structure, viral multiplication, viral cultivation, classification, inclusion bodies, antiviral agents

- Specimen collection and transport of viral disease samples to laboratory

PATHOGENIC VIRUSES – Morphology, Pathogenicity, laboratory diagnosis and prophylaxis of the following organisms

- RNA Viruses – Polio virus, influenza virus, mumps virus, measles virus, rubella virus, rabies virus, dengue virus, chickungunya virus, Japanese encephalitis virus,
- DNA Viruses – Herpes simplex virus, Varicella zoster virus, Epstein Barr virus, Variola, Molluscum contagiosum, Adeno virus, Human Papilloma virus
- Viral Hepatitis – Hepatitis A, B, C, D and E
- Rota Virus
- SARS Virus, Corona virus
- Human Immunodeficiency Virus (HIV)

PATHOGENIC FUNGI – Morphology, pathogenicity, laboratory diagnosis and prophylaxis of the following organisms

- Introduction, classification of fungi and fungal diseases, antifungal agents
- Superficial mycoses, subcutaneous mycoses, systemic mycoses and opportunistic mycoses
- Mycetism and mycotoxicosis.

UNIT-V **10 Hrs**

PARASITOLOGY – Mode of infection, pathogenicity, clinical picture, laboratory diagnosis of the following parasites

- **Protozoans:**Entamoeba histolytica, Trichomonas vaginalis, Leishmania donovani, Plasmodium spp., Toxoplasma gondii, Pneumocystis jirovecii, Cryptosporidium parvum
- **Cestodes:**Taeniasolium, Taenia saginata, Diphylobothrium latum
- **Trematodes:**Schistosoma haematobium, Fasciola hepatica, Fasciolposis buskii, Clonrchis sinensis, Paragonimuswestermanii
- **Nematodes:**Ascaris lumbricoides, Ankylostoma duodenale, Enterobius vermicularis, Strongyloidesstercoralis, Wucherariabancrofti.

Course Outcomes:

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

- Describe the General Properties and physiological aspects of Bacteria, Culture media, culture methods and identification of Bacteria.
- Explain about immunity, antigen, antibody and various antigen-antibody reactions, immune mechanisms and hypersensitivity reactions along sterilization & disinfections methods and various infection control practices.
- Describe the morphology, pathogenesis, laboratory diagnosis and prophylactic measures of various bacterial infections.
- Describe the General Properties of Viruses and Fungi and morphology, pathogenesis, laboratory diagnosis and prophylactic measures of various viral and fungal infections.

- Classify the parasites and describe the morphological forms, life cycle, pathogenesis, laboratory diagnosis and prophylactic measures of various parasitic infections.

PRACTICALS **Total: 30 Hrs**

Students undergoing the course shall be able to:

- Perform commonly employed bed-side tests for detection of infectious agents such as blood film for malaria, filariasis, gram staining, AFB staining, serology and stool sample for ova and cyst.
- Use the correct method of collection, storage and transport of clinical material for microbiological investigations

The assessment of the students will be done with the help of the following exercises:

- Spotters
- Performing Gram stain, Acid-fast staining
- Stool Examination

Textbooks:

1. The Short Textbook of Medical Microbiology (including Parasitology): Satish Gupte
2. Medical Parasitology: C P Baveja & V Baveja
3. Ananthanarayan and Paniker's Textbook of Microbiology for Nurses

Reference Books:

1. Ananthanarayan and Paniker's Text book of Microbiology-12th Edition
2. Apurba Sastry,S; Bhat,S; Essentials of Medical Microbiology –4th Edition
3. Baveja. C.P; Text book of Microbiology – 7th Edition
4. Paniker's Text book of Medical Parasitology – 9th Edition

ALLIED HEALTH SCIENCES
1st Year: 2nd Semester

AHSJ1305	**PATHOLOGY**	**L T P C**
		3 1 2 5

Course Description:

Pathology is a vast expanding and ever-changing subject and it's the key to understanding diseases worldwide. The allied health sciences are an endeavour to present this vast subject understandably to the learners.

The aim of Teaching/learning Pathology at AHS is to provide knowledge/insight into etiology, pathogenesis, and pathophysiology &diseases.

Course Objectives:

- Describe the normal structure of a cell functions & its probable disease version. (cell in health disease)
- Cellular responses to injury& Adaptations, reversible irreversible injuries
- Inflammation & repair sequence of events happening during this.
- Infections, hemodynamic, Immunopathology, neoplasia, nutritional genetic disorder in disease conditions
- Systemic pathology ... Starting from the Heart, blood vessels, hematopathology.
- System-wise diseases discussion respiratory, GIT, hepatobiliary, urinary, MGT, FGT, Breast, Bones & joints, endocrines, Diabetes, skin, CNS & eye.
- Experiencing the practice of Clinical Pathology Starting with anticoagulants, HB estimation, blood, cell counts, haematocrit, PBS, ESR, RC, BM, examination, CSF, Semen analysis, urine &other body fluids.
- Make the student understand the overall subject matter.

THEORY **Total: 60 Hrs**

UNIT-I **12 Hrs**

General Pathology -General pathology provides an overview of the basic pathologic mechanisms underlying diseases including cellular adaptations, inflammation, tissue repair, Chronic inflammation, hemodynamic disorders, immunological disorders, neoplasia, genetics and effects of radiation.

UNIT-II **12 Hrs**

Systemic Pathology 1 -Deals with various organ systems like vascular, Cardiac, LN, Respiratory system, head and neck, GIT, liver & hepatobiliary system.

UNIT-III **12 Hrs**

Systemic Pathology 2- pancreas, Urinary, Male genital system, female genital system, breast, bones, joints, soft tissue tumors, endocrines, Diabetes, Skin, CNS, peripheral nerves &Skeletal system.

UNIT-IV **12 Hrs**

Haemato pathology -Disorders of RBCs, WBCs, Platelets, anaemias, leukaemias, disorders of haemostasis, coagulation disorders, plasma cell disorders& blood

UNIT-V **12 Hrs**

Clinical pathology – deals with anticoagulants, Hb estimation blood cell counts, haematocrit, ESR, Reticulocyte count, BM examination, semen analysis, CSF and other body fluids analysis, urine examination

Course outcome:

At the end of the course, the student can be able to expand/ learn

- Define& practice of Pathology
- Haematological consequences of the disease process
- Can be able to expand the Pathogenesis, pathophysiology, clinical consequences of disease process, complications

PRACTICALS **Total: 30 Hrs**

(Only theoretical lectures as there is no provision of technicians, or logistics provided for practicals for AHS students).

Hb estimation, RBC count, WBC count, platelet count, PBS, ESR, PCV, fluids, Urine examination.

Assessment of the student will be:

- Assignments
- Midterm examinations
- Workbook

References

- A well-illustrated textbook is available for AHS students – Text of pathology for AHS students – DR. Ramdas Nayak
- Robbins & cotran textbook of pathology
- Harsh mohan textbook of pathology
- Anderson’s textbook of pathology
- Bancroft textbook of histological techniques

ALLIED HEALTH SCIENCES

1st Year: 2nd Semester

AHSJ1306	**PHARMACOLOGY**	**L T P C**
		3 1 2 5

Course Description:

This course will cover general pharmacology with special emphasis on common drugs used, drug nomenclature, their routes of drug administration, dosage formulations, dose and frequency of administration.

This course also covers side effects, toxicity, management of their toxicity and drug interactions.

Course Objectives:

Students undergoing this course are expected to:

- Describe the general principles of drug action, handling of drugs by the body and drugs acting on ANS & autacoid system.
- Explain the mechanism of action, therapeutic uses and adverse effects of drugs used in common CNS disorders.
- Explain the mechanism of action, therapeutic uses and adverse effects of drugs used in common cardiovascular diseases and haematological disorders.
- Explain the mechanism of action, therapeutic uses and adverse effects drugs used in common endocrine, respiratory and gastrointestinal disorders.
- Enlist drugs used in common infections, cancers and immunological disorders and explain their mechanism of action.

THEORY **Total: 60 Hrs**

UNIT-I **12 Hrs**

General Pharmacology: Introduction, Definitions, Sources of Drugs, Drug nomenclature –Routes of administration & Pharmacokinetics – Pharmacodynamics – Factors modifying drug action – Adverse Drug Effects & Pharmacovigilance.

Drugs Acting on Autonomic Nervous System: Cholinergic Drugs –Anticholinergic Drugs – Adrenergic Drugs – Antiadrenergic Drugs

Autacoids and Related Drugs: Histamine and Antihistaminics –Prostaglandins, Leukotrienes (Eicosanoids) and Platelet Activating Factor – Nonsteroidal Anti-inflammatory Drugs (Antipyretic-Analgesics).

UNIT-II **9 Hrs**

Drugs Acting on Central Nervous System: General Anaesthetics –Local anaesthetics– Sedative & Hypnotics – Antiepileptic Drugs – Antiparkinsonian Drugs – Antipsychotic and mood stabilizers – Antidepressant and Antianxiety Drugs – Opioid Analgesics and Antagonists – Skeletal muscle relaxants.

UNIT-III **11 Hrs**

Cardiovascular Drugs: Drugs Affecting Renin-Angiotensin System & CCBs –Diuretics – Cardiac Glycosides and Drugs for Heart Failure – Antianginal Drugs –Antihypertensive Drugs – Antiarrhythmic Drugs – Hypolipidemic Drugs

Drugs Affecting Blood and Blood Formation: Haematinics and Erythropoietin –

Coagulants & Anticoagulants – Antiplatelet drugs & Fibrinolytics – IV fluids, Plasma expanders & Drugs for shock.

UNIT-IV **10 Hrs**

Hormones and Related Drugs: Introduction, Thyroid Hormone and Thyroid Inhibitors –Insulin, Oral Hypoglycaemic Drugs and Glucagon – Corticosteroids– Sex hormones & Hormonal Contraceptives –Drugs Affecting Calcium Balance – Tocolytics & Ecbolics.

Respiratory System Drugs: Drugs for Cough – Drugs for Bronchial Asthma

Gastrointestinal Drugs: Drugs for Peptic Ulcer and Gastroesophageal Reflux Disease – Antiemetic & Prokinetic drugs – Drugs for Constipation and Diarrhoea

UNIT-V **18 Hrs**

Antimicrobial Drugs: Beta-Lactam Antibiotics- Penicillins – Cephalosporins, Monobactams & Carbapenems – Sulfonamides, Cotrimoxazole and Quinolones – Tetracyclines and Macrolides – Aminoglycosides and Misc. Antibacterial Antibiotics – Antitubercular Drugs & Antileprotic Drugs – Antifungal Drugs – Antiviral Drugs (Non- retroviral) – Antiviral Drugs (Anti - retroviral) – Antimalarial Drugs – Antiamoebic and Other Antiprotozoal Drugs – Anthelmintic Drugs

Chemotherapy of Neoplastic Diseases: Anticancer Drugs

Miscellaneous Drugs: Immunosuppressant Drugs – Drugs Acting on Skin and Mucous Membranes – Antiseptics and Disinfectants – Ocular Pharmacology

Course Outcomes:

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

- Apply the pharmacokinetic and pharmacodynamics principles that describe drug actions.
- Explain the rationale for selection of suitable drugs used in various CNS disorders.
- Explain the rationale for selection of suitable drugs used in various cardiovascular and haematological disorders.
- Explain the rationale for selection of suitable drugs used in various endocrine, respiratory and gastrointestinal disorders.
- Explain the rationale for selection of suitable drugs used in common infections, cancers and immunological disorders.

PRACTICALS **Total: 30 Hrs**

Course Objective: The course will cover general pharmacology with special emphasis on route of administration, type of formulations, dose and frequency of administration, importance of manufacturing and expiry dates, storage instructions of each drug, calculation of drug doses and general principles in the management of poisoning.

The assessment of the students will be done with the help of following exercises.

- Spotters
- Dosage calculations
- Dosage formulations

Textbooks:

1. Textbook of Pharmacology for Dental & Allied Health Sciences – Padmaja Uday Kumar- 5th edition- 2023.
2. Fundamentals of Pharmacology for Allied Health Science- Dr Pradnya Deolekar- 3rd edition- 2019.
3. Textbook of Pharmacology for Allied Sciences- Kamalakannan - 3rd edition- 2019.

Reference Books:

1. Essentials of Medical Pharmacology - K.D. Tripathi- 8th edition Reprint-2023.
2. Basic & Clinical Pharmacology. Katzung BG (Ed), Publisher: Prentice Hall International Ltd., London- 15th Edition-2021.

B Sc. MEDICAL LABORATORY TECHNOLOGY
I YEAR: II SEMESTER

MLTT1501 FUNDAMENTALS OF MEDICAL LABORATORY TECHNOLOGY L T P C
3 0 0 3

Course Description:
This course provides a comprehensive overview of laboratory services and management, focusing on the operational, safety, ethical, and quality assurance aspects essential for effective laboratory functioning. It covers the infrastructure and personnel requirements, the collection and handling of specimens, the importance of safety and biosafety measures, ethical considerations in laboratory practice, and the management of biomedical waste. Through this course, students will gain an understanding of the standards and protocols necessary for maintaining high-quality laboratory services.

Course Objectives:
Students undergoing this course are expected to:

1. Understand Laboratory Classifications and Functions
2. Master Laboratory Infrastructure Requirements
3. Develop Competence in Specimen Management
4. Implement Safety and Biosafety Protocols
5. Apply Ethical Principles and Quality Assurance Practices

UNIT I **9 hours**

1. Laboratory Services: levels of laboratories - Primary level, Secondary level, and tertiary level. Reference laboratories, Research laboratories and specific disease reference laboratories.
2. Infrastructure In the laboratories.
   a) Laboratory space: Reception, specimen collection, water supply, power supply, work area, specimen / sample / slide storage, cold storage, record room, washroom, biomedical waste room, fire safety, etc.
   b) Personnel In the laboratory: Qualifications as per NABL document.
   c) Equipment: Listing, cleaning, maintenance, SOP, verification of performance: Internal quality control.
   d) Reagents and materials: Purchase, maintenance, storage, use.

UNIT II **9 hours**

1.	Specimen Collection, storage and Transport:	General guidelines of collection, labeling, handling, transportation storage of specimens. Care in handling specimens. Accession list, Worksheet, reporting test results, Specimen rejection record, Recording of Laboratory data, Maintenance of records.
2.	Standard operating Procedure:	Definition, format, text of SOP, types of SOP.

UNIT III **9 hours**

1.	Safety in Laboratories:	General safety measures, biosafety precautions, levels of biosafety laboratories: BSL 1, BSL 2, BSL 3, BSL 4.
2.	Accidents and emergencies in the laboratory.	

UNIT IV **9 hours**

1.	Ethical considerations	Non - maleficence, beneficence, risk minimization, institutional arrangement, ethical review, transmission of ethical values, voluntariness, compliance.
2.	Quality assurance	Internal and external quality assessment.

UNIT V **9 hours**

1. Biomedical waste management.

Total Hours: 45 hours

Course Outcomes:

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

1. Identify and list the different levels of laboratories and their specific functions.
2. Explain the principles and practices of biosafety precautions and the various biosafety levels.
3. Implement specimen management protocols and general safety measures in the laboratory.
4. Evaluate the ethical principles in laboratory practice and analyze the requirements for effective laboratory infrastructure.
5. Develop comprehensive standard operating procedures (SOPs) and design a biomedical waste

management plan.

References: -

1. ICMR (2008) guidelines for good clinical laboratory practices.
2. Hospital waste Management — Chapter 13. Park's Textbook of Preventive and Social Medicine; 18th Ed.
3. NIH — DAIDS guidelines for Good Clinical Laboratory Practice Standards; 2011.
4. WHO — Good Clinical Laboratory Practice (GCLP), 2009.

Textbooks:

1. "Manual of Clinical Microbiology" (12th Edition) by Karen C. Carroll, Michael A. Pfaller
2. "Clinical Laboratory Management" (2nd Edition) by Lynne S. Garcia, Franklin R. Cockerill III
3. Cheesbrough, M. "District Laboratory Practice in Tropical Countries." Cambridge University Press, 2006

SECOND YEAR – THIRD SEMESTER

3rd Semester							
S. No	**Course Code**	**Course Name**	**Periods per week**			**Credits**	**Hours per week**
			L	**T**	**P**		
1	**MLTT2501**	General Bacteriology and Immunology	3	1	0	4	4
2	**MLTT2502**	Metabolism of Biochemistry	3	1	0	4	4
3	**MLTT2503**	Histopathology, Cytopathology & Hematopathology	3	1	0	4	4
4	**MLTL2501**	General Bacteriology and Immunology - Practical	0	0	4	2	4
5	**MLTL2502**	Metabolism of Biochemistry – Practical	0	0	4	2	4
6	**MLTL2503**	Histopathology, Cytopathology & Hematopathology - Practical	0	0	4	2	4
7	**TAUT2101**	University Core - III (Health and wellness)	2	1	0	3	3
8	**TAUT2201**	University Elective III	2	1	0	3	3
9	--	Mentoring	0	0	0	0	1
10	--	Library	0	0	0	0	1
11	--	Physical Activity	0	0	0	0	1
12	--	Extra-curricular activities	0	0	0	0	2
13	--	Self-Learning	0	0	0	0	1
	TOTAL		**13**	**5**	**12**	**24**	**36**

B Sc. MEDICAL LABORATORY TECHNOLOGY
II YEAR: III SEMESTER

MLTT2501	**GENERAL BACTERIOLOGY AND IMMUNOLOGY**	**L T P C**
		3 1 0 4

Course Description:
This course covers principles of microbiology and the impact these organisms have on man and the environment. Topics include the various groups of microorganisms, their structure, physiology, genetics, microbial pathogenicity, infectious diseases, and immunology.

Course Objective:
Students undergoing this course are expected to:

1. To understand the basic microbial morphology, demonstrate theory in microscopy, staining techniques, identify bacteria, know various culture media and their applications.
2. To understand various concepts of sterilization and disinfection, antibiotics – their resistance and susceptibility to drugs, and to learn on the bacterial and molecular genetics and the DNA amplification techniques.
3. To learn about infection and immunity: mode and source, understand antigen and antibody and their reactions.

General Bacteriology

UNIT I: 12 hours

- Introduction to Microbiology
- Historical aspect
- Microscopy
- Morphology of bacteria
- Staining techniques
- Growth and multiplication of bacteria
- Bacterial nutrition

UNIT – II: 12 hours

- Sterilization, and Disinfection
- Culture media
- Culture methods: Aerobic and anaerobic methods
- Identification of bacteria

UNIT – III: 12 hours

- Antibiotic susceptibility tests
- Bacterial genetics
- Drug resistance in bacteria.
- Molecular genetics
- DNA amplification technique

Immunology

UNIT – IV: **12 hours**

- Infection: definition, types and sources of infection, mode of transmission, types of infectious diseases
- Microbial pathogenicity
- Immunity: Types, innate immunity, acquired immunity, herd immunity
- Antigens: Types, determinants of antigenicity
- Antibodies: Structure, types, abnormal immunoglobulins

UNIT – V: **12 hours**

- Antigen-antibody reactions: General features, types, precipitation, agglutination, complement-fixation test, neutralization, opsonization, enzyme immunoassay, CLIA, Immunoelectroblot/Western blot techniques, immunochromatographic tests, immunofluorescence, flow cytometry.
- Complement system.
- Immune response: humoral immune response and cellular immune response
- Hypersensitivity: Definition, types, Type I,II, III, IV reactions
- Autoimmunity

Total – 60 hours.

Course Outcome:

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

1. Recall and describe the basic concepts and historical aspects of microbiology, including the morphology, growth, and nutritional requirements of bacteria.
2. Explain various staining techniques, methods of sterilization, and the principles of bacterial identification, including culture methods for both aerobic and anaerobic bacteria.
3. Apply appropriate culture media and techniques to isolate and identify bacteria and conduct antibiotic susceptibility tests to determine bacterial drug resistance.
4. Analyze the genetic mechanisms of bacteria, including molecular genetics and DNA amplification techniques, to understand the basis of bacterial genetics and drug resistance.
5. Evaluate the different types of immune responses, including humoral and cellular immune responses, and the mechanisms of hypersensitivity and autoimmunity.

Reference Books:

1. Mackie & McCartney Practical Medical Microbiology
2. Paniker's Textbook of Medical Parasitology: 9th ed
3. Ananthanarayan & Paniker's Textbook of Microbiology
4. Practical Microbiology for MBBS: 5th ed; C P Baveja
5. Complete Microbiology: C P Baveja & V Baveja
6. Essentials of practical Microbiology: Apurba Sankar Sastry & Sandhya Bhat K

Textbook:

1. Textbook of Microbiology and Immunology – Fourth edition by Subhash Chandra Parija
2. Essentials of Microbiology and Immunology by Dipti Pattanaik, Ashoka Mahapatra, K Sai Leela, Sunil Kumar Mohanty, First edition
3. "Bailey & Scott's Diagnostic Microbiology" by Patricia Tille,14th Edition

B Sc. MEDICAL LABORATORY TECHNOLOGY
II YEAR: III SEMESTER

MLTT2502	**METABOLISM OF BIOCHEMISTRY**	**L T P C**
		3 1 0 4

Course Description:

This course provides an in-depth exploration of the fundamental biochemical processes essential for understanding cellular metabolism and energy production. It covers the major metabolic pathways, regulatory mechanisms, and physiological implications related to carbohydrates, lipids, and proteins. The curriculum is designed for students with a foundational knowledge of biochemistry, aiming to deepen their understanding of metabolic functions and disorders. The course is divided into five units, each focused on a specific aspect of metabolism.

Course Objective:

Students undergoing this course are expected to:

1. Understanding metabolic pathways: Gain a comprehensive understanding of the major metabolic pathways involved in energy production, carbohydrate metabolism, lipid metabolism, and amino acid metabolism.
2. Clinical relevance: Learn about the clinical significance of metabolic pathways in health and disease, including the biochemical basis of metabolic disorders such as diabetes mellitus, hyperlipidaemia, and metabolic syndrome.
3. Diagnostic skills: Develop the skills to analyse and interpret metabolic biomarkers and enzyme activities for the diagnosis and monitoring of metabolic diseases using laboratory techniques such as enzymatic assays, chromatography, and spectrophotometry.

UNIT – I **12 hours**

Biological Oxidation:
High energy compounds, Mitochondrial Electron transport. Inhibitors and uncouplers of oxidative Phosphorylation.

UNIT –II **12 hours**

Digestion and absorption of Carbohydrates, Lipids, Proteins.

UNIT – **12 hours**

Carbohydrate Metabolism:
Glycolysis, TCA cycle, energy of glucose oxidation. Gluconeogenesis, Glycogenesis, Glycogenolysis and their regulations. Glycogen storage diseases, hormonal regulation of blood sugar. Brief account of Diabetes mellitus, GTT.

UNIT –IV **12 hours**

Lipid Metabolism:
Beta oxidation, Energetics of fatty acid oxidation, Fatty acid biosynthesis. Lipogenesis, ketosis. Basic idea on formation of bile salts and steroid hormones. Plasma lipoproteins. Starvation, obesity, fatty liver.

UNIT –V **12 hours**

Protein Metabolism:

Transamination, Deamination, Decarboxylation. Non-protein Nitrogenous Compounds: Urea, creatinine, and uric acid - formation, excretion, normal value.

Metabolism of Glycine, Methionine, Cysteine, Phenylalanine, Tyrosine and Tryptophan.

Total: 60 hours

Course Learning Outcome:

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

1. Recall and describe the basic concepts related to biological oxidation.
2. Explain the processes of digestion and absorption of carbohydrates, lipids, and proteins, and their significance in human physiology.
3. Apply knowledge of carbohydrate metabolism to explain the pathways of glycolysis, the TCA cycle, gluconeogenesis, glycogenesis, glycogenesis, glycogenolysis, and their regulations, and interpret the clinical implications of glycogen storage diseases and diabetes mellitus.
4. Analyze lipid metabolic pathways and their implications for health and disease.
5. Evaluate complex metabolic pathways and their physiological importance.

Reference books:

1. Clinical Chemistry – TEITZ
2. Chemical Chemistry – KAPLAN
3. Varley'spractical Clinical Chemistry.

Textbooks:

1. Textbook of Biochemistry for Medical students by Dr. D.M.Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. Rafi MD
3. Textbook of Laboratory Medicine – Praful Godkar

B Sc. MEDICAL LABORATORY TECHNOLOGY

II YEAR: III SEMESTER

MLTT2503 HISTOPATHOLOGY, CYTOPATHOLOGY & HEMATOPATHOLOGY L T P C

3 1 0 4

Course Description:

This course provides an in-depth study of histopathology, cytopathology, and hematopathology, focusing on the essential techniques, methodologies, and clinical applications. It is designed to equip students with the knowledge and practical skills necessary for diagnosing and analysing pathological specimens in a clinical laboratory setting. The course is structured into five comprehensive units, each dedicated to a specific area of study.

Course Objective:

Students undergoing this course are expected to:

1. To understand the basic microbial morphology, demonstrate theory in microscopy, staining techniques, identify bacteria, know various culture media and their applications.
2. To understand various concepts of sterilization and disinfection, antibiotics – their resistance and susceptibility to drugs, and to learn on the bacterial and molecular genetics and the DNA amplification techniques.
3. To learn about infection and immunity: mode and source, understand antigen and antibody and their reactions.

UNIT-I **12 hours**

HISTOPATHOLOGY:

a. Introduction to Histopathology:
b. Structure and functions of normal cells.
c. Reception of specimens
d. Various fixatives – Mode of action, Indications, Preparation.
e. Grossing techniques
f. Steps of tissue processing and embedding.

UNIT-II **12 hours**

HAEMATOLOGY:

g. Bone Marrow
   I. Techniques of aspiration, preparation and staining of films
   II. Bone marrow biopsy.

UNIT-III

CYTOLOGY: **12 hours**

Techniques of collection of samples

a. Exfoliative cytology
b. Interventional cytology
c. Exfoliative Cytology: Female Genital tract, Anatomy, structure and Physiology of female genital tract and Ovarian hormones, Techniques of collection of samples.

I. Pap Smears:
- Lateral Vaginal wall smears
- Vaginal 'pool' or 'vault' smears
- Cervical smears
- Combined (fast) smears.
- Triple smears (cervical-vaginal-endocervical smears)
- Endocervical and endometrial smears.

ii. Respiratory Tract
- Selection of material and making smears.
- Bronchial Aspiration (Washings) and Bronchial Brushing.

II. Urinary Tract:
- Collection and preparation of samples
- Urinary sediment Cytology
- Bladder Irrigation (Washings)
- Cytology Prostatic massage – Cytology

III. Body Fluids
- Effusions in body cavities
- Fluids of small volume.
    a) Effusions – Ascitic, plural etc.
    b) Cerebrospinal Fluid (CSF) Normal CSF, CSF in non-neoplastic & neoplastic diseases

IV. Fixation and Fixatives in Cytology:
- Routine Fixatives
- Coating Fixatives
- Special purpose fixatives
- Preservation on fluid samples

V. Processing of samples in the Laboratory.
- Staining of smears:
- Papanicolou's stain
- H & E stain
- Romanowsky stains like Leishman's, May Grunwald-Giemsa(MGG) and Wright's stains.

VI. Interventional Cytology:
- Fine Needle Cytology
- Imprint cytology
- Crush smear cytology.
- Biopsy sediment cytology

UNIT – IV **12 hours**

CLINICAL PATHOLOGY

- Urine examination. Physical, Chemical and Microscopic examination.
- Examination of faeces for occult blood
- Examination of body fluids, cell counts.
- Semen analysis
- Sputum examination

UNIT-V: **12 hours**

INSTRUMENTATION:

- Microscope
- Balances
- Tissue weighing machines.
- Tissue Processor
- Microtomes, Knives
- Knife sharpener.
- Automatic slide stainer
- Instruments for grossing
- Electric saw

Total: 60 hours

Course Learning Outcome:

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

1. Recall and describe the basic concepts of histopathology, including the structure and functions of normal cells, types of fixatives, and steps of tissue processing and embedding.
2. Explain the techniques of bone marrow aspiration, preparation, staining of films, and bone marrow biopsy, and understand their clinical significance.
3. Apply knowledge of cytological techniques to collect, prepare, and stain samples from various body systems, including the female genital tract, respiratory tract, urinary tract, and body fluids.
4. Analyze the results of urine examination, semen analysis, sputum examination, and body fluid cell counts to diagnose various clinical conditions.
5. Evaluate the functionality and proper use of essential laboratory instruments.

Textbooks:

1. "Histology: A Text and Atlas" by Michael H. Ross, Wojciech Pawlina, 8th Edition
2. "Clinical Hematology Atlas" by Bernadette F. Rodak, Jacqueline H. Carr, 6th Edition
3. "Cytopathology" by Behdad Shambayati, 2nd Edition
4. "Clinical Laboratory Hematology" by Shirlyn B. McKenzie, Lynne Williams, 3rd Edition
5. "Medical Laboratory Technology: Methods and Interpretations" by Ramnik Sood, 2nd Edition.

References:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.
3. Diagnostic cytology – Koss.
4. Diagnostic cytology – Pranab Dey

B Sc. MEDICAL LABORATORY TECHNOLOGY
II YEAR: III SEMESTER

MLTL2501	**GENERAL BACTERIOLOGY AND IMMUNOLOGY – PRACTICAL**	**L T P C** **0 0 2 4**

Course Description:

This course offers hands-on experience in general bacteriology and immunology, focusing on fundamental laboratory techniques essential for identifying and analysing microorganisms and immune responses. Designed for students in microbiology and related fields, this course provides practical skills necessary for clinical and research laboratories.

Course Objective:

The course will help the students to understand:

- How to prepare a smear and the operation of microscope
- Various staining techniques are performed in bacteriology.
- The operation of various equipment used in microbiology.
- The preparation of culture media and performing various culture techniques
- The different diagnostic tests used in Immunology.

Total – 40 hours.

General Bacteriology:

1. Preparation of a smear
2. Operation of a microscope
3. Morphology of bacteria
4. Hanging drop
5. Preparation of staining solutions like methylene blue, safranine, methyl violet, gram's iodine, strong carbol fuchsin, 20% sulphuric acid, Albert's stain solution etc.
6. Simple staining with methylene blue
7. Simple staining with safranine
8. Gram' staining
9. Acid-fast staining
10. Albert's staining
11. Negative staining
12. Autoclave operation.
13. Hot air oven operation
14. Incubator operation
15. Preparation of culture media like nutrient broth, peptone water, nutrient agar, blood agar, chocolate agar, MacConkey agar, sugar fermentation media, TSI agar, Simmon's media, Christensen's media etc.
16. Adjustment of pH of culture media
17. Aerobic culture methods: Streaking, stab culture, lawn culture etc.
18. Anaerobic culture methods: Preparation of RCM, operation of McIntosh Filde's jar
19. Identification of bacteria: catalase test, oxidase test IMViC Reactions, Urease test, Nitrate reduction test, sugar fermentation, TSI agar and other tests
20. Antibiotic sensitivity test: all methods

Immunology:

1. Slide agglutination test.
2. Tube agglutination test.
3. Hemagglutination test
4. Co-agglutination
5. Coomb's test
6. Precipitation
7. ELISA

Course learning outcomes:

After completion of the course, a student will be able to:

1. Recall the fundamental concepts, laboratory techniques, and procedures used in general bacteriology and immunology.
2. Explain the principles behind microbial staining techniques, culture methods, and the operation of laboratory equipment.
3. Demonstrate the ability to prepare bacterial smears and operate a microscope proficiently. They will apply this knowledge to observe and identify the morphology of bacteria.
4. Analyse the results of various staining techniques to classify and differentiate between different types of bacteria, and to identify and quantify antigens or antibodies.
5. Perform and interpret biochemical tests such as catalase test, oxidase test, IMViC reactions, and urease test to identify bacterial species. They will also carry out antibiotic sensitivity tests using various methods.

Textbooks:

1. Textbook of Practical Microbiology: 2nd Ed; Subhash Chandra Parija
2. Microbiology Theory for MLT (Medical Laboratory Technology): Namita Jaggi
3. A concise Book on Medical Laboratory Technology: C R Maiti
4. Textbook of Medical Laboratory Technology: Praful B Godkar & Darshan p Godkar

References:

1. The Short Textbook of Medical Microbiology (including Parasitology): Satish Gupte
2. District Laboratory practice in Tropcal Countries Volume 1 and 2: Monica Cheesbrough:
3. Medical Parasitology: C P Baveja & V Baveja
4. A Handbook of Medical Laboratory Technology: Editor: V. H. Talib

B Sc. MEDICAL LABORATORY TECHNOLOGY
II YEAR: III SEMESTER

MLTL2502	**METABOLISM OF BIOCHEMISTRY PRACTICAL**	**L T P C**
		0 0 2 4

Course Description:

This course offers comprehensive hands-on training in the practical aspects of biochemistry, focusing on the analysis of bodily fluids and the preparation and use of biochemical reagents. Designed for students in medical laboratory technology and related fields, this course provides essential skills for clinical and research laboratory settings.

Course Objectives:

The objective of this course is to make students to:

- Gain knowledge of laboratory equipment, safety procedures, and hazards associated with working in a laboratory setting.
- Develop the ability to perform and interpret normal urine analysis tests, including physical, chemical, and microscopic examinations.
- Master the skill of accurately weighing substances using laboratory balances and other weighing instruments.
- Develop proficiency in conducting and interpreting end-point assays for plasma glucose, total serum protein, and serum albumin.
- Gain familiarity with the techniques of serum protein electrophoresis and flame photometry through demonstration, understanding their principles and applications.

Total – 40 hours.

UNIT I: Introduction and Basic Techniques

1. Introduction to Lab Equipment, Lab Safety & Hazards
    - Overview of common laboratory equipment and their uses.
    - Essential safety protocols and identification of potential hazards in a biochemical laboratory.
2. Weighing of Substances
    - Accurate measurement and handling of solid and liquid substances using laboratory balances.
3. Measurement of pH
    - Techniques for measuring and adjusting the pH of various solutions using pH meters and indicators.
4. Preparation of Solutions
    - Methods for preparing standard solutions such as 1N HCl, 2/3N H_2SO_4, and 0.9% Normal saline.

UNIT II: Urine Analysis

1. Normal Urine Analysis
2. Analysis of Abnormal Constituents in Urine

UNIT III: Preparation of Reagents

1. Preparation of Reagents
    - Preparation of commonly used biochemical reagents such as Benedict's solution, Bromocresol Green (BCG), Jaffe’s reagent, and phosphate buffer.

UNIT IV: End Point Assays

1. End Point Assays: Plasma Glucose and Total Serum Protein and Serum Albumin
2. End Point Assays: Blood Urea, Serum and Urine Creatinine, Total & Conjugated Bilirubin, Uric Acid

UNIT V: Advanced Techniques and Spotters

1. Serum Protein Electrophoresis, Flame Photometry: Demonstration
    - Demonstration of serum protein electrophoresis for protein separation and analysis.
    - Demonstration of flame photometry for the determination of sodium and potassium levels in samples.
2. Spotters
    - Identification and analysis of unknown samples or "spotters" through various biochemical techniques learned throughout the course.

Course learning outcomes:

After completion of the course, a student will be able to:

1. Recall of essential laboratory safety protocols, urine analysis techniques, preparation methods for biochemical reagents and solutions, procedures for end point assays, and principles of advanced biochemical techniques.
2. Demonstrate knowledge of lab safety procedures and the proper use of laboratory equipment.
3. Accurately prepare standard solutions and reagents required for biochemical assays.
4. Conduct and interpret normal and abnormal urine analyses, identifying key constituents and their clinical significance.
5. Perform endpoint assays to measure various biochemical parameters in blood and urine samples and evaluate the results.

Textbook:

1. Textbook of Biochemistry for Medical students by Dr. D.M. Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. Rafi MD
3. Textbook of Laboratory Medicine – Praful Godkar

Reference:

1. Clinical Chemistry – TEITZ
2. Chemical Chemistry – KAPLAN
3. Varley'spractical Clinical Chemistry.

B Sc. MEDICAL LABORATORY TECHNOLOGY

II YEAR: III SEMESTER

MLTL2503 HISTOPATHOLOGY, CYTOPATHOLOGY & HEMATOPATHOLOGY L T P C

PRACTICAL 0 0 2 4

Course Description:

This practical course provides hands-on training in histopathology, cytopathology, and hematopathology techniques essential for medical laboratory technologists. Students will learn a variety of skills ranging from specimen processing to advanced staining techniques and the examination of diverse biological samples.

Course Objective:

The course will help the students to understand:

- The techniques performed in the Histopathological section.
- The necessary skills ensuring accurate preparation and interpretation of cytological samples.
- The protocols and apply the procedures in Clinical pathology.
- Gain expertise in performing the techniques for the diagnosis of hematological disorders.
- Learn the techniques for routine mounting of museum specimens.

UNIT I: HISTOPATHOLOGY: 8 hours

Processing, Embedding, preparation of blocks, Section cutting, use and care of Microtome and Microtome knives and H & E staining.

UNIT II: CYTOLOGY: 8 hours

Preparation of reagents, Wet film preparation, Fixation, staining (H&E, 'Pap', MGG and Shorr) of vaginal smears, cervical smears, and sputum. FNAC (Fine Needle Aspiration Cytology) – preparation of smears and staining.

UNIT III: CLINICAL PATHOLOGY: 8 hours

Complete Urine Analysis Cavity Fluids and miscellaneous samples Cerebrospinal Fluid in Health & Disease Semen analysisStool examination for Occult blood.

UNIT IV: HAEMATOLOGY: **8 hours**

Complete Hemogram, Bone marrow smears – staining and examination.

UNIT V: MOUNTING OF MUSEUM SPECIMENS: 8 hours

1. Routine mounting of specimens.
2. Mounting in glass jars.
3. Special methods of mounting.

Total – 40 hours.

Course learning outcomes:

After completion of the course, a student will be able to:

1. Recall and apply laboratory protocols for processing tissue specimens, including embedding,

section cutting, and staining techniques.

2. Explain the principles behind staining techniques used in histopathology, cytopathology, and hematopathology, including the differences between staining methods and their applications.
3. Apply techniques for the comprehensive analysis of urine, cerebrospinal fluid, semen, and stool samples in clinical pathology, including physical, chemical, and microscopic examinations.
4. Analyse cytological and histological specimens to identify normal and abnormal cellular morphology and structures.
5. Evaluate and interpret laboratory results from haematological tests and clinical pathology examinations to formulate accurate diagnostic assessments and recommendations.

Textbooks:

1. Exfoliative Cytology Hand Book 1985 English M.c. Lure Lippincott
2. Clinical Diagnosis in lab methods 1984 Todd & Sanford Book Saunders
3. Hand book of pathology 2005 Harsh Mohan Anshan
4. Practical Hematology 1984 Lewis & Davis Churchill living stone
5. Histological Techniques 1982 Bancroft Churchill livingstone

Reference books:

1. Lab Techniques WHO Manual Bio-Safety 2003 W.H.O.
2. Histopathology Techniques 1974 C.F.A. Culling Butter Worth

SECOND YEAR – FOURTH SEMESTER

Fourth Semester							
S. No	**Course Code**	**Course Name**	**Periods per week**			**Credits**	**Hours per week**
			L	**T**	**P**		
1	**MLTT2504**	Systemic Bacteriology	3	1	0	4	4
2	**MLTT2505**	Analytical Techniques and Instrumentation – I	3	1	0	4	4
3	**MLTT2506**	Cytopathology and mounting of museum specimens	3	1	0	4	4
4	**MLTL2504**	Systemic Bacteriology – Practical	0	0	8	4	8
5	**MLTL2505**	Analytical Techniques and Instrumentation – I – Practical	0	0	7	4	7
6	**MLTL2506**	Cytopathology and mounting of museum specimens – Practical	0	0	7	4	7
7	--	Mentoring	0	0	0	0	1
8	--	Library	0	0	0	0	1
9	--	Physical Activity	0	0	0	0	1
10	--	Extra-curricular activities	0	0	0	0	1
11	--	Self-Learning	0	0	0	0	0
	TOTAL		**9**	**3**	**20**	**24**	**36**

B Sc. MEDICAL LABORATORY TECHNOLOGY

II YEAR: IV SEMESTER

MLTT2504	**SYSTEMIC BACTERIOLOGY**	**L T P C**
		3 1 0 4

Course Description:

This course provides an in-depth study of various bacterial pathogens and their characteristics, focusing on identification, pathogenesis, and clinical significance. Students will explore the diversity of bacterial species, their microbiological features, and their roles in infectious diseases and environmental microbiology.

Course objectives:

The objective of this course is to make students:

- To gain knowledge about general characters of common pathogenic bacteria.
- To identify various Bacteria with latest biomedical techniques and can demonstrate the diseases associated with them.
- To learn about the normal microbial flora of the human body and to understand the bacteriology of water, milk, and air.

UNIT – I: Gram-Positive Cocci **12 hours**

- Staphylococcus; Streptococcus; Enterococcus; Pneumococcus.
- Neisseria meningitides, Neisseria gonorrhoeae

UNIT – II: Gram-Positive Bacilli and Enterobacteriaceae **12 hours**

- Corynebacterium; Bacillus, Clostridium species
- Escherichia coli, Klebsiella, Proteus, Salmonella, Shigella, Enterobacter

UNIT – III: Other Gram-Negative Bacilli and Acid-Fast Bacilli **12 hours**

a) Vibrio
b) Pseudomonas
c) Yersinia
d) Hemophilus

Acid-fast bacilli

a) Mycobacterium tuberculosis
b) Mycobacterium leprae

UNIT – IV: Spirochetes and Other Specialized Bacteria **12 hours**

a) Spirochetes: Treponema
b) Borrelia
c) Leptospira
d) Actinomycetes
e) Rickettsiaceae

UNIT – V: Diverse Bacterial Species and Environmental Microbiology **12 hours**

a) Bordetella
b) Brucella
c) Chlamydia
d) Miscellaneous bacteria: Helicobacter, Campylobacter, Acinetobacter, Legionella
e) Normal microbial flora of the human body
f) Bacteriology of water, milk, and air

Total - 60 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall the names and distinguishing characteristics of major bacterial genera and species across different taxonomic groups studied in the course.
2. Explain the physiological and pathological differences among Gram-positive cocci, Gram-negative bacilli, acid-fast bacilli, spirochetes, and other specialized bacteria, based on their unique features and clinical relevance.
3. Utilize laboratory techniques to isolate, culture, and identify bacterial species, employing appropriate staining methods and culture media to characterize microbial isolates effectively.
4. Interpret epidemiological data and clinical case studies to assess the role of various bacterial pathogens in disease causation, emphasizing transmission routes and implications for public health.
5. Assess the diagnostic accuracy of bacteriological methods and their implications for treatment decisions and infection control measures in clinical and environmental settings.

Textbooks:

1. Mackie & McCartney Practical Medical Microbiology
2. Paniker's Textbook of Medical Parasitology: 9th ed
3. Ananthanarayan & Paniker's Textbook of Microbiology

Reference Books:

1. Practical Microbiology for MBBS: 5th ed; C P Baveja
2. Complete Microbiology: C P Baveja & V Baveja
3. Essentials of practical Microbiology: Apurba Sankar Sastry & Sandhya Bhat K

B Sc. MEDICAL LABORATORY TECHNOLOGY

II YEAR: IV SEMESTER

MLTT2505 ANALYTICAL TECHNIQUES AND INSTRUMENTATION-1 L T P C

3 1 0 4

Course Description:

This course covers fundamental laboratory techniques and advanced instrumentation used in biochemical analysis, focusing on optical techniques, electrochemistry, porphyrins, hemoglobin, bile pigments, electrophoresis, and organ function tests.

Course Objectives:

The objective of this course is to make students to:

- To understand the principles and application of laboratory materials and to gain knowledge of safety measures and protocols.
- To master photometric and spectrophotometric techniques for quantitative analysis of substances in solution and to understand the principles and applications of biosensors and other equipment's for analytical purposes.
- Develop an understanding of the chemistry of porphyrins, their metabolism, and disorders and the catabolism of heme, and their implications in clinical diagnosis and management.
- Define and understand the principles of electrophoresis, including the various methods and types.
- Gain proficiency in conducting and interpreting liver function tests and renal function tests, including understanding the biochemical markers used in these tests and their clinical significance.

UNIT – I **12 hours**

General Laboratory Techniques & Procedures:
Lab materials- glassware & plastic ware, volumetric equipment, centrifuges, solutions, mixers & homogenizers, filtration & concentration, balances, units, buffers, safety measures.

UNIT – II **12 hours**

Optical Techniques and Electrochemistry:
Photometry, Spectrophotometry, flame photometry, atomic absorption spectrophotometry.
Electrochemistry:
Potentiometry, voltammetry, amperometry, coulometry, conductometry,
biosensors.

UNIT – III **12 hours**

Porphyrins, Hemoglobin and Bile Pigments:
Chemistry of porphyrins, Disorders of porphyrin metabolism, Hemoglobinopathies, catabolism of heme.

UNIT – IV **12 hours**

Electrophoresis:
Definition, Principle, Basics, method, types, clinical applications including Serum Protein Electrophoresis, Hemoglobin Electrophoresis.

UNIT – V **12 hours**

Organ Function Tests:
Liver function tests, Renal function tests.

Total – 60 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and list the basic principles and procedures of general laboratory techniques, optical techniques, electrochemical methods, and electrophoresis.
2. Explain the underlying principles of optical techniques like spectrophotometry and electrochemical methods such as potentiometry and conductometry, detailing their applications in biochemical analysis.
3. Apply knowledge of laboratory techniques to perform accurate measurements and analyses using instruments such as spectrophotometers and electrophoresis apparatus.
4. Analyze data obtained from biochemical tests and instrumentation to interpret results, identify abnormalities in porphyrin, hemoglobin, and bile pigment metabolism, and evaluate organ function based on test outcomes.
5. Evaluate the effectiveness of different analytical techniques and instrumentation in diagnosing and monitoring biochemical disorders, considering their accuracy, sensitivity, and clinical relevance in healthcare settings.

Textbooks:

1. Text book of Biochemistry for Medical students by Dr. D.M.Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. Rafi MD
3. Textbook of Laboratory Medicine – Praful Godkar

Reference Books:

1. Clinical Chemistry – TEITZ
2. Chemical Chemistry – KAPLAN
3. Varley's practical Clinical Chemistry.

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II YEAR: IV SEMESTER

MLTT2506 CYTOPATHOLOGY – 2 AND MOUNTING OF MUSEUM SPECIMENS L T P C

3 1 0 4

Course Description:

This course provides comprehensive training in cytology and histopathology techniques, covering fixation methods, processing of samples, staining procedures, and specimen preparation for diagnostic purposes.

Course Objectives:

The objective of this course is to make students to:

- Understand fixation methods and their importance in cytology.
- Master sample processing and staining techniques for cytological analysis.
- Analyze cytological features in PAP smears and various body fluids.
- Learn the principles and practices of fine needle aspiration cytology (FNAC).
- Explore and apply alternative cytological techniques such as imprint, crush smear, and biopsy sediment cytology, alongside mastering mounting techniques for museum specimens.

UNIT I - 12 hours

A. Fixation and fixatives in cytology
   - Introduction to fixation and fixatives
   - Autolysis and putrefaction – explanation and definition.
   - Functions of fixatives.
   - Aims and effects of fixation.
   - Effects of fixatives on tissues.
   - Types of fixations.
   - Methods of adequate fixation.
   - Techniques of fixation.
   - Factors affecting fixation.
   - Chemical fixation.
   - Pitfalls in fixation

B. Processing of samples and staining of smears in cytology
   - Introduction.
   - Labeling
   - Processing of samples – FNAC, fluids etc.
   - Staining of FNAC samples
   - Processing and staining of fluid cytology samples.
   - Staining of PAP smears.
   - Pitfalls in staining.
   - Cell block technique.

UNIT II - 12 hours

A. PAP smear

- Anatomy of cervix and vagina
- Cytological morphology of cervix and vagina
- Ovarian hormones and its role
- Cytomorphological features of normal PAP.
- Cytomorphological features in various hormonal stages of endometrium.
- Cytomorphological features in pregnancy.
- Cytomorphological features in infective etiologies.
- Differences between normal, benign, and malignant cytomorphological features of PAP smear.

B. Respiratory tract
- Bronchial aspiration
- Bronchial brushings

C. Urinary tract
- Collection of urine samples.
- Preparation of urine sample.
- Urine sediment cytology.
- Bladder irrigation.

D. Body fluids
- Receiving body fluid samples.
- Preparation of body fluid samples.
- CSF - staining, physical and chemical parameters, microscopy.
- Ascitic fluid – staining, physical and chemical parameters, microscopy.
- Pleural fluid - staining, physical and chemical parameters, microscopy.
- Miscellaneous body fluids - staining, physical and chemical parameters, microscopy.

UNIT III – **12 hours**

FNAC (fine needle aspiration cytology)
- Introduction
- FNAC as a tool in clinical investigation.
- Advantages of FNAC.
- Limitations of FNAC.
- Practice of FNAC.
- Equipment in FNAC.
- Preparation of FNAC.
- Processing of FNAC samples.
- Comparison between air dried and wet fixed smears.
- Microscopic features in pathologic conditions.

UNIT IV - **12 hours**

A. Imprint cytology
- Indications
- Contraindications
- Applications

B. Crush smear cytology.

- Indications
- Contraindications
- Applications

C. Biopsy sediment cytology
- Indications
- Contraindications
- Applications

UNIT V – Mounting of museum specimens. **12 hours**
- Preliminary steps to mount the museum specimens.
- Museum jars/ boxes.
- Mounting of specimens.
- Mounting in glass jars.
- Gelatin embedding.
- Plastination and its steps.
- Pitfalls.

Total 60 hours

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall the principles of fixation and staining techniques used in cytology to prepare high-quality diagnostic slides.
2. Explain the cytological features observed in PAP smears and FNAC samples across different physiological and pathological conditions.
3. Apply cytological techniques proficiently to process and analyze samples for accurate diagnostic purposes.
4. Analyze microscopic findings from cytological samples to interpret and diagnose various pathological conditions effectively.
5. Demonstrate proficiency in mounting and preserving museum specimens using specialized techniques such as plastination and gelatin embedding.

Textbooks:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.

Reference Books:

1. Diagnostic cytology – Koss.
2. Diagnostic cytology – Pranab Dey

B Sc. MEDICAL LABORATORY TECHNOLOGY

II YEAR: IV SEMESTER

MLTL2504 SYSTEMIC BACTERIOLOGY PRACTICAL L T P C

0 0 8 4

Course Description:

This practical course covers essential laboratory techniques and procedures in systemic bacteriology and serology. Students will gain hands-on experience in processing clinical specimens such as blood, urine, sputum, pus, stool, and throat swabs. They will learn staining techniques including Gram staining, Ziehl-Neelsen staining, and Albert's staining for the identification and characterization of bacterial pathogens. Practical sessions will also focus on colony morphology observation, biochemical tests for bacterial identification, and antibiotic sensitivity testing. In serology, students will perform various diagnostic tests to detect specific antibodies and antigens associated with bacterial infections.

Course Objectives:

The objective of this course is to make students to:

- Process the various samples for laboratory diagnosis of pathogenic bacteria.
- Various staining techniques are performed in bacteriology.
- The preparation of culture media and performing various culture techniques
- Identification of Bacteria based on colony morphology and diagnosis of bacteria based on serological tests.

Total 120 hours

Bacteriology: 56 hours

1) Processing of Blood, urine, sputum, pus, stool, throat swabs etc.
2) Gram staining
3) Ziehl-neelsen staining.
4) Albert’s staining
5) Identification of Bacteria by Colony morphology
6) Identification of Bacteria by Biochemical tests
7) Antibiotic sensitivity testing

Serology: 64 hours

1) ASLO
2) CRP
3) RA
4) Widal test
5) VDRL
6) RPR
7) TPHA
8) Weil-Felix test

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall the procedures and protocols for processing clinical specimens and performing staining techniques like Gram staining and Ziehl-Neelsen staining.

2. Explain the principles behind biochemical tests used for bacterial identification and antibiotic sensitivity testing.
3. Apply laboratory skills to interpret colony morphology and biochemical test results to identify bacterial species accurately.
4. Analyse and interpret serological test results to diagnose bacterial infections based on antibody-antigen reactions.
5. Develop proficiency in conducting serological tests independently and applying knowledge to recommend appropriate treatment options based on antibiotic sensitivity results.

Textbook:

1. "Bailey & Scott's Diagnostic Microbiology" by Patricia Tille
2. "Koneman's Color Atlas and Textbook of Diagnostic Microbiology" by Gary W. Procop, Elmer W. Koneman
3. "Diagnostic Immunology" by Richard Coico, Geoff Sunshine

Reference Book:

1. "Clinical Microbiology Procedures Handbook" by Amy L. Leber
2. "Serological and Molecular Methods for the Diagnosis of Infectious Diseases" edited by K. Chandrasekaran

B Sc. MEDICAL LABORATORY TECHNOLOGY
II YEAR: IV SEMESTER

MLTL2505	**ANALYTICAL TECHNIQUES AND INSTRUMENTATION-1**	**L T P C**
	PRACTICAL	**0 0 6 3**

Course Description:

This course offers comprehensive training in the preparation of key biochemical reagents and the execution of fundamental end point assays commonly used in clinical biochemistry. Students will also gain practical skills in advanced techniques such as serum protein electrophoresis and flame photometry. The course is designed to provide both theoretical knowledge and hands-on experience, ensuring students are well-prepared for careers in clinical laboratories.

Course Objectives:

The objective of this course is to make students to:

- Master the preparation of essential biochemical reagents.
- Perform accurate endpoint assays for glucose and serum proteins.
- Conduct endpoint assays for renal and hepatic function markers with precision.
- Demonstrate proficiency in serum protein electrophoresis and flame photometry techniques.
- Apply theoretical knowledge through practical execution in spotters for comprehensive understanding.

Total – 60 hours.

UNIT I: Preparation of reagents - Benedicts, BCG, Jaffe's reagent, Phosphate buffer.

UNIT II: End Point Assays - Plasma Glucose, Total Serum Protein, and Serum Albumin.

UNIT III: End Point Assays: Blood Urea, serum and urine Creatinine, total & conjugated bilirubin, uric acid.

UNIT IV: Serum protein electrophoresis, flame photometry: Demonstration.

UNIT V: Spotters - Identify and explain the significance of various biochemical compounds used as spotters.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the chemical composition and preparation methods of key biochemical reagents
2. Explain the principles behind end point assays for plasma glucose, total serum protein, serum albumin, blood urea, creatinine, bilirubin, and uric acid.
3. Perform and accurately execute end point assays and advanced techniques such as serum protein electrophoresis and flame photometry.
4. Interpret assay results to assess the clinical significance of biochemical parameters in diagnosing and monitoring health conditions.
5. Critically evaluate and troubleshoot potential errors in reagent preparation and assay procedures to ensure accurate and reliable results.

Textbooks:

1. Text book of Biochemistry for Medical students by Dr . D.M.Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. Rafi MD
3. Textbook of Laboratory Medicine – Praful Godkar

Reference Books:

1. Clinical Chemistry – TEITZ
2. Chemical Chemistry – KAPLAN
3. Varley'spractical Clinical Chemistry

B Sc. MEDICAL LABORATORY TECHNOLOGY

II YEAR: IV SEMESTER

MLTL2506 CYTOPATHOLOGY – 2 AND MOUNTING OF MUSEUM SPECIMENS L T P C

PRACTICAL 0 0 6 3

Course Description:

This course provides an in-depth exploration of cytology exercises and the mounting of museum specimens. Students will learn the entire process of handling cytological samples, from fixation to preparation and staining, including the use of various staining techniques like H&E, MGG, and PAP stains. Additionally, the course covers the detailed steps involved in the preparation and mounting of museum specimens. Practical sessions will equip students with the necessary technical skills to excel in clinical and research laboratory settings.

Course Objectives:

The objective of this course is to make students to:

- Master cytology techniques: fixation, processing, preparation, labeling, and staining.
- Learn cell block preparation for cytological analysis.
- Acquire skills in mounting museum specimens effectively.
- Understand the importance of labeling and staining techniques in cytology and specimen mounting.
- Ensure preservation and presentation quality of mounted museum specimens.

Total – 60 hours.

UNIT I: Fixation and Processing in Cytology

UNIT II: Preparation and Labeling of Cytological Samples

UNIT III: Staining Techniques in Cytology

- H&E stain
- MGG stain
- PAP stain

UNIT IV: Preparation of Cell Blocks

UNIT V: Mounting of museum specimens.

a) Preliminary steps
b) Mounting of specimens.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the principles and methods of fixation, processing, preparation, labeling, and staining of cytological samples.
2. Explain the significance and procedures of different staining techniques (H&E, MGG, PAP) and their applications in cytology.
3. Perform and execute the preparation, staining, and mounting of cytological slides and museum specimens accurately.

4. Interpret and analyze the results of cytological staining to identify cellular morphology and diagnose pathological conditions.
5. Integrate various cytological techniques to prepare high-quality cell blocks and museum specimens for educational and diagnostic purposes.

Textbooks:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.

Reference Books:

1. Diagnostic cytology – Koss.
2. Diagnostic cytology – Pranab Dey

THIRD YEAR – FIFTH SEMESTER

Fifth Semester							
S. No	**Course Code**	**Course Name**	**Periods per week**			**Credits**	**Hours per week**
			L	**T**	**P**		
1	MLTT3501	Systemic Virology and Mycology	3	1	0	4	4
2	MLTT3502	Analytical Techniques and Instrumentation - II	3	1	0	4	4
3	MLTT3503	Histopathology, Cytopathology Haemaopathology and Museum Techniques	3	1	0	4	4
4	MLTL3501	Systemic Virology and Mycology - Practical	0	0	7	4	7
5	MLTL3502	Analytical Techniques and Instrumentation - II – Practical	0	0	6	3	6
6	MLTL3503	Histopathology, Cytopathology Haemaopathology and Museum Techniques - Practical	0	0	6	3	6
7	MLTT3601	Artificial Intelligence in Microbiology - I	3	0	0	3	3
8	--	Mentoring	0	0	0	0	0
9	--	Library	0	0	0	0	0
10	--	Physical Activity	0	0	0	0	0
11	--	Extra-curricular activities	0	0	0	0	1
12	--	Self-Learning	0	0	0	0	0
	TOTAL		**12**	**3**	**20**	**24**	**36**

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: V SEMESTER

MLTT3501	**SYSTEMIC VIROLOGY AND MYCOLOGY**	**L T P C**
		3 1 0 4

Course Description:

This course provides a comprehensive study of viruses and fungal infections, focusing on their properties, types, and the diseases they cause. The syllabus covers various viral families and their associated infections, alongside an in-depth examination of mycological diseases, ranging from superficial to systemic mycoses. The course integrates theoretical knowledge with practical insights to equip students with a thorough understanding of virology and mycology.

Course Objectives:

The objective of this course is to make students to:

- Understand the general properties and classification of viruses and fungal organisms.
- Identify and describe the characteristics and pathogenesis of various viral families.
- Learn the mechanisms of viral infections and the host's immune responses.
- Understand the classification, diagnosis, and treatment of fungal infections.
- Analyze the epidemiology and clinical manifestations of viral and fungal diseases.

UNIT-I: **12 hours**

- General properties of viruses
- Viral infections
- Bacteriophages

UNIT – II: **12 hours**

- Poxviruses
- Herpesviruses
- Adenoviruses
- Parvoviruses
- Papovaviruses

UNIT – III: **12 hours**

- Picornaviruses
- Orthomyxoviruses
- Paramyxoviruses
- ARBO viruses
- Rhabdoviruses

UNIT – IV: **12 hours**

- Hepatitis viruses
- Human Immunodeficiency virus
- Rotavirus

- Coronaviruses
- Oncogenic viruses

UNIT - V: **12 hours**

- General Mycology
- Superficial mycoses
- Subcutaneous mycoses
- Systemic mycoses
- Opportunistic mycoses

Total - 60 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the general properties, classification, and life cycles of various viruses and fungi.
2. Explain the mechanisms of viral and fungal infections, including pathogenesis and host immune responses.
3. Perform diagnostic techniques and laboratory procedures to identify and analyze viral and fungal infections.
4. Interpret clinical data to diagnose viral and fungal infections and recommend appropriate treatment strategies.
5. Critically assess the effectiveness of different diagnostic, preventive, and therapeutic approaches for managing viral and fungal diseases.

Textbooks:

1. Mackie & McCartney Practical Medical Microbiology
2. Paniker's Textbook of Medical Parasitology: 9th ed
3. Ananthanarayan & Paniker's Textbook of Microbiology

Reference Books:

1. Practical Microbiology for Allied Health Professionals, 5th ed; C P Baveja
2. Complete Microbiology: C P Baveja & V Baveja
3. Essentials of practical Microbiology: Apurba Sankar Sastry & Sandhya Bhat K

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: V SEMESTER

MLTT3502 ANALYTICAL TECHNIQUES AND INSTRUMENTATION-2 L T P C
3 1 0 4

Course Description:

This course offers an in-depth study of advanced biochemical and diagnostic techniques essential for clinical applications. It covers chromatography, biostatistics, optical techniques, endocrinology, and the regulation of water, electrolytes, and acid-base balance. Through theoretical knowledge and practical exercises, students will gain a comprehensive understanding of these essential topics in clinical biochemistry.

Course Objectives:

The objective of this course is to make students to:

- Understand the principles and applications of chromatography in clinical diagnostics.
- Apply fundamental concepts of biostatistics to analyze clinical data.
- Learn the principles and applications of various optical techniques used in diagnostics.
- Comprehend the chemistry, classification, and mechanism of action of hormones and their associated disorders.
- Understand the regulation and clinical significance of water, electrolytes, and acid-base balance in the human body.

UNIT -I **12 hours**

Chromatography:
Definition, Principle, Basics, method, types, clinical applications.

UNIT –II **12 hours**

Biostatistics:
Fundamental concepts, sampling distributions, measures of central tendencies and Variation, regression and correlation, F-test, t-lest.

UNIT –III **12 hours**

Optical techniques:
Fluorometry, Nephelometry, Turbidimetry

UNIT –IV **12 hours**

Endocrine System:
Chemistry and classification of hormones, mechanism of action of hormones, hormones secreted by hypothalamic pituitary axis, thyroid, parathyroid, pancreas, adrenal, gonads, associated pathological conditions and function tests.

UNIT –V **12 hours**

Water & Electrolyte Balance and Acid Base Balance:
Water & Electrolyte Balance: Body water compartments, osmotic pressure, regulation of body fluid osmolarity and volume, metabolism of water, sodium, potassium, and chloride along with clinical disorders.
Acid Base Balance: Blood buffers, acid base balance, acidosis, alkalosis.

Total 60 hours

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the fundamental principles and clinical applications of chromatography, biostatistics, optical techniques, endocrinology, and electrolyte and acid-base balance.
2. Explain the methodologies and significance of different diagnostic techniques, including chromatography, statistical analysis, and optical methods, in clinical settings.
3. Perform and accurately execute laboratory procedures for chromatography, optical techniques, and endocrine function tests, and analyze biostatistical data.
4. Interpret and critically analyze laboratory results and clinical data to diagnose disorders related to hormonal imbalances, water and electrolyte disturbances, and acid-base balance.
5. Assess the effectiveness and reliability of various diagnostic techniques and statistical methods in clinical biochemistry and propose improvements or alternative approaches.

Textbooks:

1. Text book of Biochemistry for Medical students by Dr. D.M.Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. Rafi MD
3. Textbook of Laboratory Medicine – Praful Godkar

Reference Books:

1. Chemical Chemistry – KAPLAN
2. Clinical Chemistry – TEITZ
3. Varley'spractical Clinical Chemistry.

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: V SEMESTER

MLTT3503 HISTOPATHOLOGY, CYTOPATHOLOGY HAEMAOPATHOLOGY AND MUSEUM TECHNIQUES

L	T	P	C
3	1	0	4

Course Description:

This course offers comprehensive training in histotechnology and advanced techniques essential for diagnostic pathology and research. Students will learn the principles and practical applications of tissue sectioning, staining techniques, immunocytochemistry, cryostat procedures, special stains, and advanced technologies like flow cytometry, tissue culture, and cytogenetics. The course integrates theoretical knowledge with hands-on laboratory practice to develop proficiency in histological techniques and their diagnostic applications.

Course Objectives:

The objective of this course is to make students to:

1. Master the techniques of tissue sectioning, staining, and microscopic analysis for diagnostic histopathology.
2. Understand the principles and applications of immunocytochemistry and special stains in histotechnology.
3. Gain practical skills in operating advanced laboratory equipment such as cryostats, flow cytometers, and microscopes.
4. Learn the basics of tissue culture and cytogenetic techniques essential for research and clinical applications.
5. Explore museum techniques for specimen preservation and display.

UNIT – I: **12 hours**

A. Section cutting
B. Mode of preparation and theory of H&E staining
C. Various aspects of mounting and staining of slides
D. Theory of decalcification and various methods
E. Use of microscopes – light microscope & polarizing microscope.
F. Phase contrast microscope & fluorescent microscope.

UNIT – II: **12 hours**

IMMUNOCYTOCHEMISTRY -

A. Basic concepts of immunochemistry
B. PAP technique – principle, preparation of reagent and procedure
C. Immunocytochemical methods (immunoperoxidase and immunoalkaline phosphatase)

FROZEN SECTION & CRYOSTAT -

A. Frozen section – freezing microtome, frozen section technique
B. Cryostat – types, operation of cryostat, cryostat cut sections.

UNIT – III: **12 hours**

SPECIAL STAINS

A. Mucicarmine
B. PAS
C. Sudan black
D. Oil red O
E. Alcian blue
F. Congo red
G. Verhoeff's stain for elastic tissue
H. Mallory's phosphotungstic acid hematoxylin stain (PTAH)
I. Connective tissue stains

UNIT – IV: **12 hours**

Introduction of following -

A. Flow & Imaging cytometry.
B. Tissue culture
C. Cytogenetics

UNIT – V: **12 hours**

A. Museum techniques

Total 60 hours

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the fundamental principles and techniques of histotechnology, including section cutting, staining methods, microscopy, immunocytochemistry, cryostat procedures, and museum techniques.
2. Explain the rationale behind each histotechnology technique and its application in diagnostic pathology and research, integrating theoretical understanding with practical examples.
3. Demonstrate proficiency in performing histotechnology procedures such as section cutting, staining, immunocytochemistry, and museum specimen preparation accurately and efficiently.
4. Analyze histological slides and museum specimens to interpret tissue structures, identify pathological conditions, and evaluate the quality of staining and preparation techniques using microscopic observation and diagnostic criteria.
5. Critically assess the effectiveness of different histotechnology methods and staining techniques in achieving diagnostic accuracy and specimen preservation, proposing improvements based on experimental outcomes and scientific evidence.

Textbooks:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.

Reference Books:

1. Diagnostic cytology – Koss.
2. Diagnostic cytology – Pranab Dey

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: V SEMESTER
PROGRAM SPECIFIC ELECTIVE

MLTT3601	**ARTIFICIAL INTELLIGENCE IN CLINICAL MICROBIOLOGY – I**	**L T P C** **3 0 0 3**

Course Description:

This course provides a comprehensive exploration of the integration of artificial intelligence (AI) into clinical microbiology. It covers the fundamental principles of AI and its transformative applications in microbial detection, diagnosis, antimicrobial stewardship, epidemiological surveillance, and pathogen genomics. Through theoretical knowledge and practical case studies, students will gain insights into how AI is revolutionizing the field of clinical microbiology, enhancing diagnostic accuracy, and optimizing treatment strategies.

Course Objectives:

The objective of this course is to make students to:

1. Understand the basic concepts of AI and its relevance to healthcare and clinical microbiology.
2. Explore AI-driven diagnostic tools and their applications in microbial identification.
3. Learn about AI-driven approaches to antimicrobial stewardship and their impact on treatment optimization.
4. Examine AI-enhanced epidemiological surveillance methods for outbreak detection and disease spread prediction.
5. Gain knowledge on AI-assisted pathogen genomics for genome sequencing, analysis, and outbreak tracking.

UNIT I: **9 hours**

introduction to AI in clinical microbiology

- Overview of AI and its applications in healthcare
- Introduction to clinical microbiology and its significance
- Role of AI in advancing microbial detection and diagnosis

UNIT II: **9 hours**

AI-Based Diagnostic Tools

- Machine learning algorithms for microbial identification
- Image recognition techniques in microbiological analysis
- Case studies on AI-based diagnostic tools in clinical microbiology

UNIT III: **9 hours**

AI-Driven Antimicrobial Stewardship

- AI applications in antimicrobial resistance prediction
- Optimization of antimicrobial therapy using AI algorithms
- Challenges and limitations in implementing AI-driven antimicrobial stewardship programs.

UNIT IV: **9 hours**

AI-Enhanced Epidemiological Surveillance

- AI-driven methods for outbreak detection and monitoring
- Predictive modelling of infectious disease spread using AI.
- Integration of AI with traditional surveillance methods in epidemiology

UNIT V: **9 hours**

AI-Assisted Pathogen Genomics

- Genome sequencing and bioinformatics in clinical microbiology
- AI algorithms for genomic analysis and interpretation
- Applications of AI in tracking and tracing microbial outbreaks

Total – 45 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the basic principles of AI and its various applications in clinical microbiology for microbial detection, diagnosis, and surveillance.
2. Explain the methodologies and rationale behind AI-based diagnostic tools, antimicrobial stewardship programs, and epidemiological surveillance methods in clinical microbiology.
3. Apply machine learning algorithms and AI-driven techniques to identify microbes, predict antimicrobial resistance, and optimize antimicrobial therapies in clinical settings.
4. Analyze case studies and real-world examples of AI-enhanced diagnostic tools and surveillance systems to evaluate their effectiveness and impact on clinical microbiology practices.
5. Integrate knowledge of AI algorithms, genomic analysis, and traditional microbiological methods to develop innovative solutions for microbial detection, diagnosis, and outbreak management.

Textbooks:

1. "Artificial Intelligence in Healthcare" by Adam Bohr and Kaveh Memarzadeh
2. "Machine Learning for Healthcare" by Kevin Murphy and Will Hedgecock
3. "Artificial Intelligence: Concepts and Applications" by N.P. Padhy and Manas Ranjan Patra
4. "Principles and Practice of Clinical Microbiology" by B. S. Nagoba and A. H. Pichare.

Reference books:

1. "Artificial Intelligence in Healthcare: A Practical Guide" by Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher
2. "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again" by Eric Topol
3. "Clinical Microbiology: Diagnostic Principles and Practice" by Lynne S. Garcia.

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: V SEMESTER

MLTL3501	**SYSTEMIC VIROLOGY AND MYCOLOGY PRACTICAL**	**L T P C**
		0 0 8 4

Course Description:

This course provides hands-on training in the practical aspects of virology and mycology, essential for diagnosing and managing infectious diseases. Students will learn the methods and techniques required for the collection, transport, and storage of specimens, as well as the cultivation and identification of viruses and fungi. Through detailed laboratory exercises, the course covers various diagnostic tests, including ELISA, Western blot, RT-PCR, and culture methods, along with critical protocols for maintaining safety and hygiene in handling infectious agents.

Course Objectives:

The objective of this course is to make students to:

1. Learn proper collection, transport, and storage techniques for viral and fungal specimens.
2. Proficiency in culturing viruses using chick embryos.
3. The practical experience in performing serological tests for viral infections like HIV, HBV, HCV, dengue fever, and chikungunya fever.
4. Perform molecular diagnostic techniques such as RT-PCR for COVID-19 and other viral infections.
5. Hands-on experience in sample collection, preparation of culture media, staining procedures, and slide culture techniques for mycological analysis.

Total – 120 hours.

Virology:

1. Collection, transport, and storage of specimens for viral infection
2. Cultivation of viruses: Chick embryo
3. Hemagglutination inhibition test
4. Paul-Bunnel test
5. HIV: ELISA test for detection of p24antigen, for detection of antibodies, Western blot test, HIV-tridot test
6. HBV: ELISA test for HBsAg, immunochromatographic test etc.
7. HCV: ELISA test for HCV
8. Dengue fever: ELISA test for detection of antigen, detection of antibody
9. Chikungunya fever: ELISA test for detection of antibody
10. RT-PCR test for COVID-19 and other tests for COVID-19
11. Hand hygiene, Doffing, and donning of Personal Protective Equipment (PPE)

Mycology:

1. Sample collection and transport.
2. Preparation of SDA and other culture media
3. Staining procedures in Mycology like Lactophenol cotton blue stain, Calcofluor white, fluorescent stain, Gram's, Negative staining etc.

4. KOH mount
5. Slide culture.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the fundamental procedures for the collection, transport, and storage of viral and fungal specimens.
2. Explain the principles and methodologies of various diagnostic tests such as ELISA, Western blot, and RT-PCR for detecting viral and fungal infections.
3. Demonstrate the ability to prepare culture media, perform staining procedures, and cultivate viruses and fungi using appropriate techniques.
4. Analyze the results of diagnostic assays and staining methods to identify and differentiate between various viral and fungal pathogens.
5. Integrate knowledge of safety protocols, including hand hygiene and PPE usage, to design and implement effective laboratory practices for handling infectious agents.

Textbooks:

1. Textbook of Practical Microbiology: 2nd Ed; Subhash Chandra Parija
2. A Handbook of Medical Laboratory Technology: Editor: V. H. Talib
3. Microbiology Theory for MLT (Medical Laboratory Technology): Namita Jaggi
4. A concise Book on Medical Laboratory Technology: C R Maiti
5. The Short Textbook of Medical Microbiology (including Parasitology): Satish Gupte
6. Textbook of Medical Laboratory Technology: Praful B Godkar & Darshan p Godkar
7. District Laboratory practice in Tropcal Countries Volume 1 and 2: Monica Cheesbrough:
8. Medical Parasitology: C P Baveja & V Baveja

Reference Books:

1. Mackie & McCartney Practical Medical Microbiology
2. Paniker's Textbook of Medical Parasitology: 9th ed
3. Ananthanarayan & Paniker's Textbook of Microbiology
4. Practical Microbiology for MBBS: 5th ed; C P Baveja
5. Complete Microbiology: C P Baveja & V Baveja
6. Essentials of practical Microbiology: Apurba Sankar Sastry & Sandhya Bhat K

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: V SEMESTER

MLTL3502	**ANALYTICAL TECHNIQUES AND INSTRUMENTATION-2**	**L T P C**
	PRACTICAL	**0 0 6 3**

Course Description:

This course provides a comprehensive understanding and hands-on experience in various biochemical assays and techniques used in clinical diagnostics. Students will learn to perform endpoint and kinetic assays for essential biochemical parameters, as well as immunoassays for specific protein detection. The course emphasizes the practical application of these assays in diagnosing and monitoring different medical conditions.

Course Objectives:

The objective of this course is to make students to:

1. Develop skills in conducting assays for calcium, phosphorus, cholesterol, urinary proteins, CSF-protein, and glucose, ensuring accurate measurements.
2. Gain comprehension of kinetic assays for alkaline phosphatase and amylase and learn to interpret kinetic data effectively.
3. Understand the principles and practical application of immunoassay techniques through Ferritin immunoassay demonstration.
4. Acquire practical laboratory skills, including sample preparation, assay execution, and data interpretation.
5. Learn quality control measures to ensure the reliability and reproducibility of biochemical analysis outcomes.

Total 90 hours

1) End Point Assays: Calcium, phosphorus.
2) End Point Assays: cholesterol, urinary proteins, CSF-protein, and glucose.
3) Kinetic Assays: Alkaline phosphatase, Amylase
4) Immuno Assays: Ferritin-Demonstration

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the principles and procedures of various endpoint and kinetic assays used in clinical biochemistry.
2. Explain the methodologies and clinical significance of biochemical assays for parameters such as calcium, phosphorus, cholesterol, urinary proteins, and glucose.
3. Perform and accurately interpret endpoint and kinetic assays, as well as immunoassays, for diagnosing and monitoring different medical conditions.
4. Analyze and troubleshoot assay results to identify potential errors and ensure accuracy in biochemical testing.
5. Assess the effectiveness of laboratory safety protocols and quality control measures in maintaining the reliability of biochemical assay results.

Textbooks:

1. Textbook of Biochemistry for Medical students by D.M. Vasudevan

2. Textbook of Biochemistry for Medical students by Dr. MD. Rafi
3. Textbook of Laboratory Medicine – Praful Godkar

Reference Books:

1. Biochemistry by U. Satyanarayana
2. Clinical Chemistry – TEITZ
3. Chemical Chemistry – KAPLAN
4. Varley's practical Clinical Chemistry.

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: V SEMESTER

MLTL3503	**HISTOPATHOLOGY, CYTOPATHOLOGY HAEMAOPATHOLOGY AND MUSEUM TECHNIQUES – PRACTICAL**	**L T P C** **0 0 6 3**

Course Description:

This practical course in histopathology is designed to provide students with comprehensive knowledge and hands-on experience in the use of special stains for the identification of various tissue components and pathological conditions. The course will cover a variety of staining techniques, each targeting specific cellular and tissue elements, which are crucial for accurate diagnosis and research in histopathology.

Course Objectives:

The objective of this course is to make students to:

1. Introduce students to the principles and techniques of special stains used in histopathology.
2. Provide hands-on experience in performing a range of special stains.
3. Teach students to interpret staining results and understand their clinical significance.
4. Emphasize the importance of precision and accuracy in histopathological staining techniques.
5. Ensure students can troubleshoot common issues that arise during the staining process.

Total 90 hours

Histopathology special stains

A. Mucicarmine
B. PAS
C. Sudan black
D. Oil red O.
E. Alcian blue
F. Congo red
G. Verhoeff's stain for elastic tissue
H. Mallory's phosphotungstic acid hematoxylin stain (PTAH)
I. Connective tissue stains

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall and describe the principles and methodologies of various histopathological special stains used for identifying specific tissue components and pathological conditions.
2. Explain the rationale behind the selection of different special stains and their applications in histopathological diagnosis.
3. Demonstrate proficiency in performing a variety of special staining techniques accurately and effectively.
4. Analyze stained tissue sections to interpret and differentiate various tissue components and pathological features.
5. Evaluate the diagnostic significance and clinical relevance of staining results in the context of specific diseases and conditions.

Textbooks:

1. "Theory and Practice of Histological Techniques" by John D. Bancroft and Marilyn Gamble
2. "Histotechnology: A Self-Instructional Text" by Freida L. Carson and Christa Hladik Cappellano
3. "Atlas of Special Stains in Diagnostic Hematopathology" by Yao-Tseng Chen and Peiguo Chu

Reference books:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.
3. Diagnostic cytology – Koss.
4. Diagnostic cytology – Pranab Dey

THIRD YEAR – SIXTH SEMESTER

Sixth Semester							
S. No	**Course Code**	**Course Name**	**Periods per week**			**Credits**	**Hours per week**
			L	**T**	**P**		
1	MLTT3504	Systemic Parasitology	3	1	0	4	4
2	MLTT3505	Analytical Techniques and Instrumentation - III	3	1	0	4	4
3	MLTT3506	Histopathology, Transfusion Medicine and Haemaopathology	3	1	0	4	4
4	MLTL3504	Systemic Parasitology - Practical	0	0	8	4	8
5	MLTL3505	Analytical Techniques and Instrumentation - III – Practical	0	0	6	3	6
6	MLTL3506	Histopathology, Transfusion Medicine and Haemaopathology - Practical	0	0	6	3	6
7	MLTT3602	Artificial Intelligence in Microbiology - II	3	0	0	3	3
8	--	Mentoring	0	0	0	0	0
9	--	Library	0	0	0	0	0
10	--	Physical Activity	0	0	0	0	0
11	--	Extra-curricular activities	0	0	0	0	1
12	--	Self-Learning	0	0	0	0	0
	TOTAL		**12**	**3**	**20**	**25**	**36**

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: VI SEMESTER

MLTT3504	**SYSTEMIC PARASITOLOGY**	**L T P C**
		3 1 0 4

Course Description:

This course provides a comprehensive overview of medically important parasites, focusing on their morphology, life cycles, epidemiology, and clinical manifestations. Practical sessions emphasize diagnostic techniques essential for identifying parasitic infections, ensuring students gain proficiency in laboratory methods crucial for accurate diagnosis and management.

Course Objectives:

The objective of this course is to make students to:

1. Introduce students to the diversity and classification of parasitic organisms, including protozoa and helminths.
2. Provide detailed knowledge of the life cycles, transmission, and pathogenesis of key parasitic species.
3. Equip students with practical skills in performing diagnostic tests and microscopic examinations for detecting parasitic infections.
4. Emphasize the importance of accurate specimen collection, transport, and processing in parasitological diagnostics.
5. Foster an understanding of public health implications and control measures related to parasitic diseases.

UNIT- I: Protozoology: **12 hours**

- Entamoeba histolytica
- Pathogenic free-living amoebae
- Giardia lamblia
- Trichomonas vaginalis
- Leishmania
- Trypanosomes
- Plasmodium
- Toxoplasma gondii
- Isospora belli
- Cryptosporidium parvum
- Balantidium coli

UNIT - II: **12 hours**

Helminthology: Cestodes

- Diphyllobothrium latum
- Taenia solium
- Taenia saginata
- Echinococcus granulosus
- Hymenolepis nana

UNIT – III: **12 hours**

Trematodes

- Schistosomes
- Fasciola hepatica
- Fasciolopsis buski
- Paragonimus westermani

UNIT – IV: **12 hours**

Nematodes

- Trichinella spiralis
- Trichuris trichiura
- Strongyloides stercoralis
- Ancylostoma duodenale
- Necator americanus
- Enterobius vermicularis
- Ascaris lumbricoides
- Wuchereria bancrofti
- Brugiyamalayi
- Dracunculus medinensis

UNIT – V: **12 hours**

Diagnostic methods in Parasitology Stool

- Collection and transport
- Microscopic examination
- Saline wet mount
- Iodine wet mount
- Permanent stained smears
- Concentration methods of stool
- Egg counting methods.
- Fecal culture

Total - 60 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Describe the taxonomy, morphology, life cycles, and epidemiology of medically important parasites, including protozoa and helminths.
2. Explain the clinical manifestations and pathogenesis of parasitic infections caused by protozoa and helminths.
3. Demonstrate proficiency in performing diagnostic techniques such as microscopic examination, staining procedures, and culture methods for detecting parasitic infections in clinical specimens.
4. Analyze microscopic slides to identify and differentiate various parasite species based on their morphological characteristics and life stages.
5. Evaluate the effectiveness of different diagnostic methods and laboratory procedures in accurately diagnosing parasitic infections, considering factors such as sensitivity, specificity, and practical applicability in clinical settings.

Textbooks:

1. Textbook of Practical Microbiology: 2nd Ed; Subhash Chandra Parija
2. A Handbook of Medical Laboratory Technology: Editor: V. H. Talib
3. Microbiology Theory for MLT (Medical Laboratory Technology): Namita Jaggi
4. A concise Book on Medical Laboratory Technology: C R Maiti
5. The Short Textbook of Medical Microbiology (including Parasitology): SatishGupte
6. Textbook of Medical Laboratory Technology: Praful B Godkar & Darshan pGodkar
7. District Laboratory practice in Tropcal Countries Volume 1 and 2: MonicaCheesbrough:
8. Medical Parasitology: C P Baveja & V Baveja
9. "Diagnostic Medical Parasitology" by Lynne S. Garcia

Reference Books:

1. Mackie & McCartney Practical Medical Microbiology
2. Paniker's Textbook of Medical Parasitology: 9th ed
3. Ananthanarayan & Paniker's Textbook of Microbiology
4. Practical Microbiology for MBBS: 5th ed; C P Baveja
5. Complete Microbiology: C P Baveja & V Baveja
6. Essentials of practical Microbiology: Apurba Sankar Sastry & Sandhya Bhat K

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: VI SEMESTER

MLTT3505 ANALYTICAL TECHNIQUES AND INSTRUMENTATION- 3 **L T P C**
3 1 0 4

Course Description:

This course provides a comprehensive overview of advanced techniques and methodologies used in clinical chemistry. It is structured to enhance understanding of modern analytical techniques, the principles of method evaluation, quality management, and the implementation of automation and information systems in a clinical laboratory setting. Students will gain theoretical knowledge and practical skills essential for accurate and efficient clinical analysis.

Course Objectives:

The objective of this course is to make students to:

1. Understand Immunoassays principles and applications.
2. Explore Polymerase Chain Reaction (PCR) and its applications.
3. Learn about osmosis and osmometers in clinical chemistry.
4. Analyze analytical goals including validation, calibration, precision, and accuracy.
5. Implement Total Quality Management principles and quality control programs.

UNIT –I **12 hours**

TECHNIQUES:
Immunoassays: Principle, Basics, ligand binding immunoassays including RIA, ELISA & CLIA.
PCR: Principle and applications of polymerase chain reaction (PCR).
Osmometry: Osmosis and osmometers.

UNIT –II **12 hours**

Analytical Goals & Method Evaluation
Analytical Goals: Validation of Analytical Methodology and Calibration of Equipment, Precision and accuracy, bias, sensitivity, and specificity.
Method Evaluation: Purpose, selection of method, laboratory evaluation, example/study.

UNIT –III **12 hours**

Total Quality Management:
Fundamental concepts, control of pre analytical, analytical, and post analytical variables, internal and external quality control programs.

UNIT –IV **12 hours**

Point of care testing (POCT)

UNIT- V
12 hours

Automation and Computers in Clinical Chemistry:
Automation: Definition, instrumental concepts, auto analyzers, selection of instruments, trends in automation.
Computers In Clinical Chemistry: Laboratory information systems.

Total - 60 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Describe the fundamental principles and mechanisms of immunoassays, PCR, and osmometry, including specific techniques such as RIA, ELISA, and CLIA.
2. Explain the significance of analytical goals, including validation of analytical methodologies, precision, accuracy, bias, sensitivity, and specificity in clinical chemistry.
3. Demonstrate the ability to select and evaluate appropriate analytical methods and calibrate equipment based on specific laboratory requirements.
4. Critically analyze and control pre-analytical, analytical, and post-analytical variables to ensure total quality management in a clinical laboratory setting.
5. Assess the implementation and impact of automation and computer-based laboratory information systems on the efficiency and accuracy of clinical laboratory operations.

Textbooks:

1. Text book of Biochemistry for Medical students by D.M.Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. MD. Rafi
3. Textbook of Laboratory Medicine – Praful Godkar

Reference books:

1. Biochemistry by U. Satyanarayana
2. Clinical Chemistry – TEITZ
3. Chemical Chemistry – KAPLAN
4. Varley's practical Clinical Chemistry.

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: VI SEMESTER

MLTT3506	**HISTOPATHOLOGY, TRANSFUSION MEDICINE AND HAEMAOPATHOLOGY**	**L T P C** **3 1 0 4**

Course Description:
This course provides an in-depth study of clinical pathology and hematology, focusing on advanced techniques, instrumentation, and laboratory practices. Students will gain comprehensive knowledge and practical skills in immunohistochemistry, the study of hemorrhagic disorders, blood transfusion protocols, and hematology. Emphasis is placed on modern instrumentation, quality control, and the application of computer technology in pathology and hematology laboratories.

Course Objectives:
The objective of this course is to make students to:

1. Understand immunohistochemistry principles and instrumentation, including freezing microtomes and automation.
2. Learn about coagulation mechanisms and conduct studies on hemorrhagic disorders.
3. Gain proficiency in blood transfusion practices, including blood grouping and donor selection.
4. Develop skills in basic hematology techniques and interpretation of hematological values.
5. Learn laboratory methods for investigating anemias and quality control procedures in hematology.

UNIT-I: **12 hours**

IMMUNOHISTOCHEMISTRY

A. Introduction
B. Overview of immunohistochemistry
C. Applications of immunohistochemistry

INSTRUMENTATION –

A. Freezing microtome
B. Cryostat
C. Automation in pathology
D. Application of computers in pathology

UNIT-II: **12 hours**

HEMORRHAGIC DISORDERS

A. Mechanism of coagulation
B. Collection and anticoagulants used in coagulant studies.
C. Bleeding time and clotting time
D. Other coagulation studies – PT, KPTT, TGT
E. Platelet count
F. Platelet function tests

UNIT-III: **12 hours**

BLOOD TRANSFUSION AND IMMUNOHISTOCHEMISTRY

A. ABO blood group system
B. Rh typing and weaker variants in Rh system
C. Subgroups and weaker variants of A&B, Bombay phenotype.
D. Coomb's test
E. Blood grouping & cross matching in blood bank
F. Investigations of transfusion reaction
G. Care & selection of donors.
H. Screening for Australia antigen (HbsAg)
I. HLA antigens & their significance in transfusion
J. Preservation of blood, principles & its application in blood banking
K. Screening blood for infective materials
L. Blood bank administration

UNIT-IV: **12 hours**

HEMATOLOGY

A. Blood collection
B. Anticoagulants used in hematology.
C. Normal values in hematology
D. Basic hematology techniques
   - RBC counts
   - Hemoglobin estimation
   - Packed cell volume
   - Calculation of absolute indices, WBC counts – TLC, DLC
   - Absolute eosinophil count
   - Platelet count
   - ESR
E. Preparation of blood films
F. Stains used in hematology.

UNIT-V: **12 hours**

HEMATOLOGY

A. Morphology of red cells
B. Morphology of leucocytes and platelets
C. Preparation of buffy coat smears
D. Reticulocyte count
E. laboratory methods used in the investigation of deficiency anemias.
   - B12 & folate assay
   - Schilling test
   - Serum iron & iron binding capacity\
F. Laboratory methods used in the investigation of hemolytic anemias.
   - Osmotic fragility
   - Test for sickling.
   - Estimation of HbF, HbA2

G. Organization & quality control in hematology laboratory
H. Preparation of glass ware

Course Outcomes:

After completion of the course, the student will be able to:

1. Identify and describe the principles and applications of immunohistochemistry, and the operation of relevant instrumentation such as freezing microtomes and cryostats.
2. Explain the mechanisms of coagulation, various coagulation studies, and the clinical significance of different blood typing systems including the ABO and Rh systems.
3. Demonstrate the ability to perform blood collection, anticoagulant use, and basic hematology techniques such as RBC counts, hemoglobin estimation, and blood film preparation.
4. Analyze the results of platelet function tests, Coomb's tests, and investigations of transfusion reactions to draw informed conclusions about patient health.
5. Evaluate the effectiveness of laboratory methods used in diagnosing deficiency and hemolytic anemias, ensuring adherence to quality control standards in hematology laboratory practices.

Textbooks:

1. "Textbook of Medical Laboratory Technology" by Praful B. Godkar
2. "Practical Hematology" by Tejinder Singh

Reference book:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.
3. Diagnostic cytology – Koss.
4. Diagnostic cytology – Pranab Dey

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: VI SEMESTER

MLTL3504	**SYSTEMIC PARASITOLOGY PRACTICAL**	**L T P C**
		0 0 8 4

Course Description:

This course offers a hands-on approach to the essential techniques and methodologies in systemic parasitology. Students will engage in practical exercises focused on the collection, processing, and analysis of parasitic samples from stool and blood. Emphasis is placed on mastering preparation, staining, and culture methods essential for diagnosing parasitic infections.

Course Objectives:

The objective of this course is to make students to:

1. Demonstrate proficiency in collecting and transporting samples for parasitological analysis, ensuring sample integrity.
2. Perform stool examinations using wet mount and iodine wet mount techniques to detect parasites effectively.
3. Implement concentration methods for stool samples to enhance the detection of parasitic infections.
4. Apply various staining procedures to visualize parasites in stool samples accurately.
5. Prepare thick and thin blood smears and conduct staining procedures to identify parasites present in blood samples.

Parasitology: **Total - 120 hours**

1. Sample collection and transport.
2. Stool: wet mount and iodine wet mount
3. Stool: Concentration methods
4. Stool: various staining procedures
5. Blood: Preparation of thick and thin blood smears
6. Blood: Staining procedures to demonstrate parasites in blood
7. Preparation of culture media

Course Outcomes:

After completion of the course, the student will be able to:

1. Identify and describe the protocols for sample collection, preservation, and transportation in parasitological studies.
2. Explain the principles behind stool wet mount and iodine wet mount techniques and their applications in parasite identification.
3. Demonstrate the preparation and staining of blood smears to visualize blood-borne parasites using various staining methods.
4. Compare and contrast different stool concentration methods to determine the most effective technique for enhancing parasite detection.
5. Assess the quality and suitability of culture media prepared for the growth and identification of parasitic organisms in laboratory settings.

Textbooks:

1. Textbook of Practical Microbiology: 2nd Ed; Subhash Chandra Parija
2. A Handbook of Medical Laboratory Technology: Editor: V. H. Talib
3. Microbiology Theory for MLT (Medical Laboratory Technology): Namita Jaggi
4. A concise Book on Medical Laboratory Technology: C R Maiti
5. The Short Textbook of Medical Microbiology (including Parasitology): SatishGupte
6. Textbook of Medical Laboratory Technology: Praful B Godkar & Darshan pGodkar
7. District Laboratory practice in Tropcal Countries Volume 1 and 2: MonicaCheesbrough:
8. Medical Parasitology: C P Baveja & V Baveja

Reference Books:

1. Mackie & McCartney Practical Medical Microbiology
2. Paniker's Textbook of Medical Parasitology: 9th ed
3. Ananthanarayan & Paniker's Textbook of Microbiology
4. Practical Microbiology for MBBS: 5th ed; C P Baveja
5. Complete Microbiology: C P Baveja & V Baveja
6. Essentials of practical Microbiology: Apurba Sankar Sastry & Sandhya Bhat K

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: VI SEMESTER

MLTL3505	**ANALYTICAL TECHNIQUES AND INSTRUMENTATION- 3**	**L T P C**
	PRACTICAL	**0 0 6 3**

Course Description:

This course provides practical training in essential biochemical techniques used in clinical laboratories. Students will gain hands-on experience with paper chromatography, kinetic assays, standard curve preparation, and the interpretation of diagnostic charts and tests. Emphasis is placed on developing practical skills necessary for accurate biochemical analysis and diagnosis.

Course Objectives:

The objective of this course is to make students to:

1. Understand the principles and applications of paper chromatography through demonstration, allowing for hands-on learning of the technique.
2. Learn the principles and procedures of kinetic assays for enzymes such as SGOT, SGPT, CPK, CPK-MB, and LDH, enabling accurate assessment of enzyme activity.
3. Gain proficiency in establishing standard curves for glucose and urea, essential for quantitative analysis in clinical chemistry.
4. Develop the ability to interpret and analyze spotters including LJ charts, GTT, LFT, RFT, and reference ranges, facilitating comprehensive understanding of clinical diagnostic tests.
5. Acquire practical skills in performing and interpreting various laboratory tests, enhancing competency in clinical laboratory practice.

Total - 90 hours.

UNIT I: Paper chromatography: Demonstration

UNIT II: Kinetic Assays: SGOT, SGPT, CPK, CPK-MB, LDH

UNIT III: Standards: Glucose, Urea standard curve

UNIT IV: Spotters: LJ charts, GTT, LFT, RFT, Reference ranges.

Course Outcomes:

After completion of the course, the student will be able to:

1. Remembering: Identify the principles and procedures involved in paper chromatography and various kinetic assays.
2. Understanding: Explain the process and importance of preparing and using glucose and urea standard curves for biochemical quantification.
3. Applying: Demonstrate the ability to perform and analyze results from kinetic assays such as SGOT, SGPT, CPK, CPK-MB, and LDH.
4. Analyzing: Interpret diagnostic charts and tests, including Levey-Jennings charts, Glucose Tolerance Tests, Liver Function Tests, and Renal Function Tests.
5. Evaluating: Assess the accuracy and clinical relevance of biochemical assay results, ensuring they meet established reference ranges and quality control standards.

Textbooks:

1. Text book of Biochemistry for Medical students by D.M.Vasudevan
2. Textbook of Biochemistry for Medical students by Dr. MD. Rafi
3. Textbook of Laboratory Medicine – Praful Godkar
4. Varley's practical Clinical Chemistry.

Reference book:

1. Biochemistry by U. Satyanarayana
2. Clinical Chemistry – TEITZ
3. Chemical Chemistry – KAPLAN

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: VI SEMESTER

MLTL3506	**HISTOPATHOLOGY, TRANSFUSION MEDICINE AND HAEMAOPATHOLOGY – PRACTICAL**	**L T P C 0 0 6 3**

Course Description:

This course encompasses advanced laboratory techniques essential for diagnostic pathology and hematology. Students will engage in comprehensive training on immunohistochemistry, coagulation studies, blood grouping, hematology procedures, and specialized tests. Emphasis is placed on mastering protocols, troubleshooting, quality control measures, and practical skills necessary for accurate diagnostic testing in clinical settings.

Course Objectives:

The objective of this course is to make students to:

1. Develop proficiency in immunohistochemistry techniques, covering antibody-antigen interactions, detection systems, and quality control measures.
2. Acquire practical skills in operating a freezing microtome for tissue sectioning and sample preparation.
3. Understand and perform coagulation tests, including bleeding time, clotting time, and platelet count estimation, using appropriate anticoagulants.
4. Master blood grouping techniques and Coomb's tests for antibody detection, along with essential hematology procedures like hemoglobin estimation and peripheral smear preparation.
5. Gain competence in additional hematology tests, such as reticulocyte count, sickling test, osmotic fragility, and buffy coat smear preparation, ensuring proficiency in laboratory practices.

UNIT I: Immunohistochemistry and Freezing microtome **18 hours**

A. Immunohistochemistry

- Antibodies
- Antigens
- Detection systems
- Antigen retrieval techniques
- Trouble shooting
- IHC protocol
- Quality control

B. Freezing microtome

UNIT II: Coagulation studies **18 hours**

A. Bleeding time
B. Clotting time
C. Prothrombin time
D. Activated partial thromboplastin time.
E. Estimation of platelet count
F. Anticoagulants used in coagulation studies.

UNIT III: Blood Grouping and Coomb's Test **18 hours**

A. Blood grouping – forward and reverse grouping
- tile method
- tube method
- gel card

B. Coomb's test – direct and indirect

UNIT IV: Hematology Procedures **18 hours**

A. Order of draw for blood culture
B. Anticoagulants used in hematology.
C. Hemoglobin estimation
D. Erythrocyte sedimentation rate
E. Peripheral smear and staining

UNIT – V: Specialized Hematology Tests **18 hours**

A. Reticulocyte count
B. Buffy coat smear preparation and staining
C. Osmotic fragility
D. Sickling test

Total – 90 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Recall the fundamental principles and techniques of immunohistochemistry, coagulation studies, blood grouping, hemoglobin estimation, and specialized hematology tests.
2. Explain the processes involved in immunohistochemistry, coagulation mechanisms, blood group antigen-antibody reactions, and the interpretation of hematology test results.
3. Apply skills in performing immunohistochemistry protocols, coagulation assays, blood grouping methods, hemoglobin estimation, and specialized hematology tests accurately and efficiently.
4. Analyze and interpret results from coagulation studies, blood group testing, hemoglobin estimation, erythrocyte sedimentation rate, and specialized hematology tests to make clinical decisions.
5. Evaluate the quality of laboratory procedures and results, including troubleshooting immunohistochemistry techniques, assessing the reliability of coagulation assays, ensuring accuracy in blood grouping, and interpreting hematology test outcomes in clinical contexts.

Textbooks:

1. "Clinical Laboratory Hematology" by Shirlyn B. McKenzie, Lynne Williams
2. "A Concise Textbook of Clinical Laboratory Science" by P.B. Godkar and D.B. Godkar
3. "Clinical Pathology and Laboratory Techniques" by D. R. Arora

References:

1. Histopathology techniques and its management – Ramadas Nayak.
2. Orell and Sterrett's Fine needle aspiration cytology.
3. Diagnostic cytology – Pranab Dey.
4. "Clinical Laboratory Hematology" by Shirlyn B. McKenzie, Lynne Williams (Indian Adaptation by Chatterjee).

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: V SEMESTER

PROGRAM SPECIFIC ELECTIVE

MLTT3601a	**ARTIFICIAL INTELLIGENCE IN CLINICAL MICROBIOLOGY**	**L T P C** **3 0 0 3**

Course Description:

This course provides a comprehensive exploration of the integration of artificial intelligence (AI) into clinical microbiology. It covers the fundamental principles of AI and its transformative applications in microbial detection, diagnosis, antimicrobial stewardship, epidemiological surveillance, and pathogen genomics. Through theoretical knowledge and practical case studies, students will gain insights into how AI is revolutionizing the field of clinical microbiology, enhancing diagnostic accuracy, and optimizing treatment strategies.

Course Objectives:

The objective of this course is to make students to:

6. Understand the basic concepts of AI and its relevance to healthcare and clinical microbiology.
7. Explore AI-driven diagnostic tools and their applications in microbial identification.
8. Learn about AI-driven approaches to antimicrobial stewardship and their impact on treatment optimization.
9. Examine AI-enhanced epidemiological surveillance methods for outbreak detection and disease spread prediction.
10. Gain knowledge on AI-assisted pathogen genomics for genome sequencing, analysis, and outbreak tracking.

UNIT I: **9 hours**

Introduction to AI in clinical microbiology

- Overview of AI and its applications in healthcare
- Introduction to clinical microbiology and its significance
- Role of AI in advancing microbial detection and diagnosis

UNIT II: **9 hours**

AI-Based Diagnostic Tools

- Machine learning algorithms for microbial identification
- Image recognition techniques in microbiological analysis
- Case studies on AI-based diagnostic tools in clinical microbiology

UNIT III: **9 hours**

AI-Driven Antimicrobial Stewardship

- AI applications in antimicrobial resistance prediction
- Optimization of antimicrobial therapy using AI algorithms
- Challenges and limitations in implementing AI-driven antimicrobial stewardship programs.

UNIT IV: **9 hours**

AI-Enhanced Epidemiological Surveillance

- AI-driven methods for outbreak detection and monitoring
- Predictive modelling of infectious disease spread using AI.
- Integration of AI with traditional surveillance methods in epidemiology

UNIT V: **9 hours**

AI-Assisted Pathogen Genomics

- Genome sequencing and bioinformatics in clinical microbiology
- AI algorithms for genomic analysis and interpretation
- Applications of AI in tracking and tracing microbial outbreaks

Total – 45 hours.

Course Outcomes:

After completion of the course, the student will be able to:

6. Recall and describe the basic principles of AI and its various applications in clinical microbiology for microbial detection, diagnosis, and surveillance.
7. Explain the methodologies and rationale behind AI-based diagnostic tools, antimicrobial stewardship programs, and epidemiological surveillance methods in clinical microbiology.
8. Apply machine learning algorithms and AI-driven techniques to identify microbes, predict antimicrobial resistance, and optimize antimicrobial therapies in clinical settings.
9. Analyze case studies and real-world examples of AI-enhanced diagnostic tools and surveillance systems to evaluate their effectiveness and impact on clinical microbiology practices.
10. Integrate knowledge of AI algorithms, genomic analysis, and traditional microbiological methods to develop innovative solutions for microbial detection, diagnosis, and outbreak management.

Textbooks:

5. "Artificial Intelligence in Healthcare" by Adam Bohr and Kaveh Memarzadeh
6. "Machine Learning for Healthcare" by Kevin Murphy and Will Hedgecock
7. "Artificial Intelligence: Concepts and Applications" by N.P. Padhy and Manas Ranjan Patra
8. "Principles and Practice of Clinical Microbiology" by B. S. Nagoba and A. H. Pichare.

Reference books:

4. "Artificial Intelligence in Healthcare: A Practical Guide" by Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher
5. "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again" by Eric Topol
6. "Clinical Microbiology: Diagnostic Principles and Practice" by Lynne S. Garcia.

B.Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: V SEMESTER
PROGRAM SPECIFIC ELECTIVE - I

MLTT3601b	**MEDICAL LABORATORY MANAGEMENT AND QUALITY CONTROL**	**L T P C 3 0 0 3**

Course Description:

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

Course Objectives:

The objective of this course is to make students to:

1. Understand the principles and framework of Total Quality Management (TQM) in clinical laboratories.
2. Analyse laboratory errors across the pre-analytical, analytical, and post-analytical phases and apply error-reduction strategies.
3. Apply Quality Control (IQC & EQC), Root Cause Analysis (RCA), and CAPA for error prevention and laboratory process improvement.
4. Evaluate the standards of accreditation, certification, auditing, and equipment/inventory control in clinical laboratories.
5. Demonstrate knowledge of modern laboratory practices including LIS/LIMS, Point-of-Care Testing, and regulatory compliance for patient safety.

UNIT I: **9 hours**

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.

UNIT II: **9 hours**

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.

UNIT III: **9 hours**

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 Organization for Standardization (ISO). Summarize 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.

UNIT IV: **9 hours**

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.

UNIT V: **9 hours**

Point-of-Care Testing (POCT) – Portable diagnostic devices, 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.

Total – 45 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. **Define and explain** the principles of quality management, quality indicators, and error sources in laboratory practice.
2. **Differentiate and apply** internal and external quality control methods, including Levey-Jennings charts, Westgard rules, and proficiency testing.
3. **Evaluate and justify** the role of accreditation bodies (NABL, ISO) and laboratory audits in ensuring quality assurance and compliance.
4. **Demonstrate and illustrate** the functioning of Laboratory Information Systems (LIS/LIMS), middleware, and data management for efficient laboratory operations.
5. **Compare, assess, and validate** Point-of-Care Testing devices and procedures, ensuring regulatory compliance and patient safety.

Textbooks:

1. Mirnali Sant, Textbook of Medical laboratory Technology, CBS publishers
2. Godkar PB, Textbook of Medical laboratory Technology, Bhalani publishing house

Reference books:

1. Paszko Christine, Turner Elizabeth (2001) Laboratory Information Management Systems (2nd edition) CRC Press Inc
2. Douglas Shawn (2023). The Complete Guide to LIMS and Laboratory Informatics (1st edition) LabLynx Press.

B.Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: V SEMESTER
PROGRAM SPECIFIC ELECTIVE - I

MLTT3601c	**MEDICAL LAW AND ETHICS**	**L T P C** **3 0 0 3**

Course Description:

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.

Course Objectives:

The objective of this course is to make students to:

1. To introduce the concepts of ethics, medical ethics, professional ethics, and bioethics with their historical development and guidelines.
2. To impart knowledge on human ethics, GCP, informed consent, publication ethics, and regulatory acts in clinical research.
3. To provide an understanding of the medico-legal aspects of medical records, confidentiality, and their significance in healthcare practice.
4. To familiarize students with human rights and healthcare-related acts, ensuring ethical and legal compliance in patient care.
5. To create awareness of intellectual property rights, licensing, and regulatory requirements, promoting compliance and sustainable entrepreneurship in healthcare laboratories.

UNIT I: **9 hours**

Medical and bioethics: Introduction to ethics, medical ethics, professional ethics, and bioethics, Types of Medical Ethics, goal and scope of medical ethics, History & development of bioethics, ethical
guidelines, Nuremberg code, Helsinki Declaration

UNIT II: **9 hours**

Human ethics, principles and guidelines, good clinical practice (GCP), informed consent, Clinical Trial Registry-India (CTRI), Core of Publication ethics and plagiarism, Drugs and Cosmetics Act, 1940, Schedule Y and role of investigators

UNIT III: **9 hours**

Medico legal aspects of medical records – Medico legal case and type- Records and documents related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects, medico legal importance of AIDS/HIV

UNIT IV: **9 hours**

Human Rights Act, Mental Health Act, Human Organ Transplantation Act and Disaster Management Act

UNIT V: **9 hours**

Define Intellectual property and Intellectual property rights (IPR), Types of Intellectual property rights, Licensing and regulatory requirements for medical laboratories, Importance of compliance with healthcare laws and regulations, and sustainable entrepreneurship.

Total – 45 hours.

Course Outcomes:

After completion of the course, the student will be able to:

1. Explain the principles, history, and types of medical and bioethics, along with international ethical codes and guidelines.
2. Apply ethical principles, informed consent, and GCP guidelines in clinical research and practice while adhering to regulatory frameworks.
3. Analyse medico-legal cases, ownership, confidentiality, and disclosure of medical records to ensure legal and ethical compliance.
4. Evaluate the implications of human rights and healthcare-related acts (Mental Health Act, Organ Transplantation Act, Disaster Management Act) in medical practice.
5. Integrate and design strategies for compliance with IPR, licensing, and regulatory requirements to support sustainable entrepreneurship in healthcare.

Textbooks:

1. Bonnie F. Fremgen – Medical Law and Ethics, Pearson Education
2. Jonathan Herring – Medical Law and Ethics, Oxford University Press
3. ICMR – Ethical Guidelines for Biomedical Research on Human Participants (2017)
4. John D. Angelo-Ethics in Science (2012). Ethical Misconduct in Scientific Research. CRC Press, Taylor & Francis Group

Reference books:

1. Hazel Biggs-Healthcare Research Ethics and Law. Regulation, Review & Responsibility. (2010). Cavendish Biomedical Law & Ethics Library
2. Graf, C. et al.- Best practice guidelines on publication ethics: a publisher's perspective. (2007). International journal of clinical practice, 61, 1-26
3. Gluck et al. Applied ethics in animal research: philosophy, regulation, and laboratory applications, (2002) Purdue University Press.

B Sc. MEDICAL LABORATORY TECHNOLOGY
III YEAR: VI SEMESTER
PROGRAM SPECIFIC ELECTIVE

Course Code	Advances In Diagnostic	L	T	P	C
MLTT3602a	Microbiology	3	0	0	3

Course Description:

This course provides a comprehensive exploration of the integration of artificial intelligence (AI) into clinical microbiology. It covers the fundamental principles of AI and its transformative applications in microbial detection, diagnosis, antimicrobial stewardship, epidemiological surveillance, and pathogen genomics. Through theoretical knowledge and practical case studies, students will gain insights into how AI is revolutionizing the field of clinical microbiology, enhancing diagnostic accuracy, and optimizing treatment strategies.

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

1. Understand the basic concepts of AI and its relevance to healthcare and clinical microbiology.
2. Explore AI-driven diagnostic tools and their applications in microbial identification.
3. Learn about AI-driven approaches to antimicrobial stewardship and their impact on treatment optimization.
4. Examine AI-enhanced epidemiological surveillance methods for outbreak detection and disease spread prediction.
5. Gain knowledge on AI-assisted pathogen genomics for genome sequencing, analysis, and outbreak tracking.

Unit I: Introduction to AI in clinical microbiology **9 Hours**

- Overview of AI and its applications in healthcare
- Introduction to clinical microbiology and its significance
- Role of AI in advancing microbial detection and diagnosis

Unit II: AI-Based Diagnostic Tools **9 Hours**

- Machine learning algorithms for microbial identification
- Image recognition techniques in microbiological analysis
- Case studies on AI-based diagnostic tools in clinical microbiology

Unit III: AI-Driven Antimicrobial Stewardship **9 Hours**

- AI applications in antimicrobial resistance prediction
- Optimization of antimicrobial therapy using AI algorithms
- Challenges and limitations in implementing AI-driven antimicrobial stewardship programs.

Unit IV: AI-Enhanced Epidemiological Surveillance **9 Hours**

- AI-driven methods for outbreak detection and monitoring
- Predictive modelling of infectious disease spread using AI.
- Integration of AI with traditional surveillance methods in epidemiology

Unit V: AI-Assisted Pathogen Genomics **9 Hours**

- Genome sequencing and bioinformatics in clinical microbiology
- AI algorithms for genomic analysis and interpretation
- Applications of AI in tracking and tracing microbial outbreaks

Total: 45 hours

Course Outcomes:

Upon completion, students will be able to:

1. Recall and describe the basic principles of AI and its various applications in clinical microbiology for microbial detection, diagnosis, and surveillance.
2. Explain the methodologies and rationale behind AI-based diagnostic tools, antimicrobial stewardship programs, and epidemiological surveillance methods in clinical microbiology.
3. Apply machine learning algorithms and AI-driven techniques to identify microbes, predict antimicrobial resistance, and optimize antimicrobial therapies in clinical settings.
4. Analyze case studies and real-world examples of AI-enhanced diagnostic tools and surveillance systems to evaluate their effectiveness and impact on clinical microbiology practices.
5. Integrate knowledge of AI algorithms, genomic analysis, and traditional microbiological methods to develop innovative solutions for microbial detection, diagnosis, and outbreak management.

Textbook

1. "Artificial Intelligence in Healthcare" by Adam Bohr and Kaveh Memarzadeh
2. "Machine Learning for Healthcare" by Kevin Murphy and Will Hedgecock
3. "Artificial Intelligence: Concepts and Applications" by N.P. Padhy and Manas Ranjan Patra
4. "Principles and Practice of Clinical Microbiology" by B. S. Nagoba and A. H. Pichare.

Reference

1. "Artificial Intelligence in Healthcare: A Practical Guide" by Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher
2. "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again" by Eric Topol
3. "Clinical Microbiology: Diagnostic Principles and Practice" by Lynne S. Garcia.

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: VI SEMESTER

PROGRAM SPECIFIC ELECTIVE

Course Code MLTT3602b **Preventive and Social Medicine (PSM)**

Course Rationale:

This course provides Medical Laboratory Science (MLS) students with a public health perspective, emphasizing the role of the laboratory in disease prevention, community health, and national health programs. It bridges laboratory diagnostics with population-level health outcomes.

Course Objectives:

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

1. Understand the fundamental link between laboratory diagnostics and the public health surveillance system.
2. Identify community-level health challenges, including infectious disease outbreaks, and articulate the laboratory's immediate and long-term response.
3. Demonstrate knowledge of safe environmental practices and statutory requirements for biomedical waste management.
4. Apply communication strategies to advocate for preventive health measures and disease control within the community.
5. Recognize the ethical and professional responsibility of an MLS professional in managing resources and ensuring safety during public health emergencies.

Unit I: Concepts of Public Health and Epidemiology **9 Hours**

Introduction to Public Health: Definition, scope, and objectives of Preventive and Social Medicine (PSM). Levels of prevention (Primary, Secondary, Tertiary). The concept of 'Health' and its social/environmental determinants.

Basic Epidemiology: Definition, uses, and measurement of health and disease (Rates, Ratios, Proportions). The Epidemiological Triad (Agent, Host, Environment). Concept of Herd Immunity.

Disease Dynamics: Reservoir of infection, source of infection, carrier state, incubation period, isolation, and quarantine. Laboratory's role in active and passive surveillance.

Unit II: Environmental Health and Biomedical Waste Management **9 Hours**

Water, Air, and Sanitation: Standards for drinking water (WHO/BIS), water purification methods at domestic and community levels. Air pollution sources, effects, and monitoring (role of lab). Basic sanitation and sewage disposal methods.

Vector Control: Brief overview of medically important vectors (Mosquitoes, Flies, Rodents) and control measures (chemical, biological, environmental).

Biomedical Waste Management (BMWM): Introduction to BMWM Rules (e.g., India's BMWM Rules). Classification, segregation (colour coding), collection, transport, treatment (autoclaving, incineration), and disposal of biomedical waste.

Unit III: Communicable Diseases and National Health Programs **9 Hours**

Epidemiology of Key Communicable Diseases: Tuberculosis, HIV/AIDS, Malaria, Dengue, Viral Hepatitis (A, B, C). Emphasis on mode of transmission, preventive measures, and laboratory-based diagnostics (e.g., RNTCP protocols, ELISA testing).

Immunization and Cold Chain: Principles of immunization (active/passive). Types of vaccines. National Immunization Schedule (NIS) in India. Importance and maintenance of the cold chain for biologicals.

National Health Programs: Overview of National Health Mission (NHM), National Program for Control of Non-Communicable Diseases (NPCDCS), and Vector-Borne Disease Control Program.

Unit IV: Demography and Health Communication **9 Hours**

Demography and Family Welfare: Demographic cycle, vital statistics (birth/death rates). Family planning methods (temporary and permanent). Role of counselling in family welfare.

Health Education and Communication: Definition and principles of Health Education. Types and models of communication. Barriers to health communication. Effective use of media (IEC materials).

The Health Team Concept: Role of the Allied Health Professional in the community health team. Intersectoral coordination. Ethics in community practice.

Unit V: Occupational Health and Disaster Management **9 Hours**

Occupational Health: Definition and scope. Occupational hazards and diseases (physical, chemical, biological, mechanical). Prevention and control measures (e.g., TLV, ventilation). Occupational hazards for MLS professionals.

Disaster Management: Definition, classification of disasters (natural/man-made). Phases of disaster management. Role of the hospital/laboratory in disaster preparedness and response (e.g., triage, mass testing protocols, biosecurity).

Total: 45 hours

Course Outcomes:

1. Upon completion, students will be able to:
2. Explain the core principles of epidemiology and how laboratory data contribute to disease surveillance.
3. Describe the social and environmental determinants of health relevant to the Indian context.
4. Outline the function and significance of national health programs and the MLS professional's role in them.
5. Apply concepts of health education and communication for promoting preventive care.
6. Understand disaster preparedness and the laboratory's function in mass casualty events.

Textbook:

Park's Textbook of Preventive and Social Medicine.

Reference:

Mahajan's Methods in Biostatistics and Public Health

Epidemiology (Focus on study designs and disease measurement.)

Biomedical Waste Management Rules (Latest version from Ministry of Environment, Forest & Climate Change, India)

Web Link:

National Health Mission (NHM) Portal (For current national health programs and policies.)

Ministry of Health & Family Welfare (MoHFW), India

World Health Organization (WHO) India Country Office (For global health initiatives and regional data.)

National Centre for Disease Control (NCDC) (For disease surveillance and outbreak information.)

B Sc. MEDICAL LABORATORY TECHNOLOGY

III YEAR: VI SEMESTER

PROGRAM SPECIFIC ELECTIVE

Course Code		L	T	P	C
MLTT3602c	Research Methodology	3	0	0	3

Course Description:

This course provides students with foundational knowledge in scientific inquiry, study design, and data interpretation, empowering them to critically read scientific literature and conduct small-scale research projects relevant to laboratory sciences.

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

1. Understand the systematic process of scientific inquiry and its direct relevance to improving clinical laboratory practice and diagnostics.
2. Develop robust skills in formulating a focused research problem, reviewing scientific literature, and designing a methodologically sound study.
3. Apply basic biostatistical principles for summarizing data and performing initial hypothesis testing relevant to quality control and clinical validation.
4. Identify and adhere to ethical and regulatory requirements for research involving human subjects and laboratory data.
5. Acquire the necessary skills for scientific communication, including academic writing and critical appraisal of evidence.

Unit I: Fundamentals of Research and Problem Formulation 9 Hours

Introduction to Scientific Research: Definition, need, and characteristics of research. Types of research (Basic, Applied, Quantitative, Qualitative). Role of research in evidence-based laboratory medicine.

Formulating the Research Problem: Identifying and defining a research problem. Review of literature (search strategies, citation databases, systematic review basics). Formulating a clear Title, Aims, and Objectives.

Hypothesis and Variables: Defining hypothesis (Null vs. Alternative). Characteristics of a good hypothesis. Identifying and classifying variables (Dependent, Independent, Confounding).

Unit II: Research Designs and Sampling Techniques 9 Hours

Quantitative Study Designs (Observational): Descriptive studies (Case Report, Case Series, Cross-sectional). Analytical studies (Case-Control, Cohort). Measures of association (Odds Ratio, Relative Risk).

Quantitative Study Designs (Interventional): Introduction to Experimental Studies (Randomized Controlled Trials - RCTs). Blinding (Single, Double). Importance of control groups.

Sampling Methods: Definition of Population and Sample. Probability sampling (Simple Random, Stratified, Cluster). Non-probability sampling (Convenience, Purposive). Sample Size Estimation (basic concepts).

Unit III: Data Collection and Measurement **9 Hours**

Data Types and Sources:

Types of data (Primary vs. Secondary). Data measurement scales (Nominal, Ordinal, Interval, Ratio). Validity and Reliability of measurement tools.

Methods of Data Collection: Questionnaire and Interview schedules. Laboratory data acquisition (LIMS integration). Use of Logbooks and Case Record Forms (CRF).

Diagnostic Test Evaluation: Concepts of Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV). Introduction to Receiver Operating Characteristic (ROC) curves.

Unit IV: Biostatistics for Laboratory Data **9 Hours**

Descriptive Statistics: Tabulation and Graphical Presentation of data (Bar charts, Histograms, Scatter plots). Measures of Central Tendency (Mean, Median, Mode). Measures of Dispersion (Range, Standard Deviation, Coefficient of Variation).

Inferential Statistics (Parametric): Introduction to Normal Distribution. T-test (Paired and Unpaired). ANOVA (Analysis of Variance - basic concept). Selection of appropriate test.

Inferential Statistics (Non-Parametric & Correlation): Chi-Square test for categorical data. Correlation (Pearson, Spearman) and Regression (Simple Linear - basic concept).

Unit V: Ethical and Administrative Aspects of Research **9 Hours**

Research Ethics: Principles of research ethics (Respect for Persons, Beneficence, Justice). Informed Consent (process and documentation). Role and function of the Institutional Ethics Committee (IEC). Ethical guidelines for handling human biological samples.

Scientific Misconduct and Integrity: Plagiarism, Falsification, Fabrication, and Ghost Authorship. Responsible Conduct of Research (RCR). Conflict of Interest.

Scientific Writing and IPR: Structure of a research paper (IMRaD format). Basic citation styles (e.g., Vancouver/APA). Introduction to Intellectual Property Rights (IPR), Patents, and Copyrights.

Total: 45 hours

Course Outcomes:

Upon completion, students will be able to:

1. Formulate clear research questions, objectives, and hypotheses.
2. Critically appraise different types of research designs (descriptive, observational, experimental).
3. Select appropriate sampling techniques and methods for data collection.
4. Apply basic biostatistical tools for data presentation and analysis.
5. Understand ethical guidelines and intellectual property rights relevant to biomedical research.

Textbook:

B. K. Mahajan, Methods in Biostatistics for Medical Students and Research Workers

Reference

Ramalingam Thangamani A, Essentials of Research Methodology for all Physiotherapy and Allied Health Sciences Students
Stephen B. Hulley et al., Designing Clinical Research
Peter Armitage, Geoffrey Berry, J. N. S. Matthews, Statistical Methods in Medical Research

Official Guidelines

ICMR (Indian Council of Medical Research), National Ethical Guidelines for Biomedical and Health Research involving Human Participants

Web Link

CONSORT Statement (Guidelines for reporting randomized controlled trials - applicable for research design.) SPSS/R/Jamovi Software Documentation (For practical data a

FOURTH YEAR – SEVENTH & EIGHT SEMESTER

Course Code	Course Name	Periods per week			Credits	Hours per Semester
		L	T	P		
MLTI4501	Internship-I	0	0	**48**	**25**	**1104**
TOTAL				**48**	**25**	**1104**

Course Code	Course Name	Periods per week			Credits	Hours per Sester
		L	T	P		
MLTI4502	Internship-II	0	0	**48**	**25**	**1104**
MLTP4501	Project	0	0	**8**	**6**	**180**
TOTAL				**51**	**31**	**1284**

B Sc. MEDICAL LABORATORY TECHNOLOGY

IV YEAR: VII & VIII SEMESTER

		L	T	P	C
MLTI450	**INTERNSHIP**	**0**	**0**	**50**	**50**

The internship will span 1 year. This will include 6 hours of practice a day, totaling 1500 hours during internship semester. As a part of this, the students will maintain a work logbook which will be duly endorsed by the supervisor or trainer. At the end of internship, the candidate shall submit the work logbook along with certificate from the training institute. Finally, the training of a candidate shall be evaluated by the internal and external examiners deputed by university in the form of practical / viva examination.

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in clinical delivery of services. Students will demonstrate competence in beginning and intermediate procedures. Students will observe the advanced and specialized procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction. The students are expected to work for a minimum of 6 hours per day and this may be more depending on the need and the healthcare setting.

Course description:

The internship for BSc MLT spans one year, providing students with extensive practical training across key departments of clinical laboratories. This hands-on experience aims to develop confidence, proficiency, and advanced skills necessary for a career in medical laboratory technology.

Course Objectives:

CO1: Skill Development: Develop competence in beginning and intermediate laboratory procedures relevant to microbiology, biochemistry, pathology, and blood banking.

CO2: Observational Learning: Observe and understand advanced and specialized procedures in clinical laboratory settings.

CO3: Clinical Practice: Apply theoretical knowledge gained in classrooms to practical settings, demonstrating proficiency in conducting diagnostic tests and analyses.

CO4: Logbook Maintenance: Maintain a detailed work logbook endorsed by supervisors or trainers, documenting daily activities and achievements during the internship.

Internship (Practical training:1500 Hours)		
Section	**Topics**	**Hours**
General Microbiology	Media Preparation, Sterilization Techniques, Aseptic Techniques	**80**
Clinical Microbiology	Sample Collection and Handling, Diagnostic Microbiology, Bacteriology, Antimicrobial Susceptibility Testing	**180**
Serology and Immunology	Serological Tests, Immunoassays, Flow Cytometry, Allergy Testing	**120**
Virology, Mycology, and Parasitology	Virus Culture, Identification, and Quantification; Fungal Culture and Identification; Parasite Identification and Life Cycle Studies	**120**
General Biochemistry	Buffer Preparation, Spectrophotometry	**80**
Protein Biochemistry	Protein Extraction and Purification, Protein Quantification, Electrophoresis, Western Blotting	**120**
Analytical Biochemistry	Chromatography, Mass Spectrometry	**120**
Enzymology	Enzyme Assays, Kinetics, Inhibition Studies	**80**
Nucleic Acid Biochemistry	DNA/RNA Extraction, PCR, Gel Electrophoresis, ELISA	**120**
Lipid Biochemistry	Lipid Extraction and Analysis, Lipid Quantification	**80**
Carbohydrate Biochemistry	Sugar Analysis, Glycoprotein Analysis	**80**
Clinical Biochemistry	Blood and Urine Analysis, Hormone and Drug Assays	**80**
Histopathology	Tissue Processing, Microscopic Examination, Special Stains, Immunohistochemistry	**100**
Cytopathology	Sample Collection and Preparation, Staining and Examination, Diagnostic Cytology	**100**
Hematology and Blood Bank	Blood Sample Analysis, Peripheral Blood Smears, Bone Marrow Examination, Coagulation Studies, Blood Typing, Crossmatching, Blood Storage, and Transfusion Protocols	**120**
Total		**1500**

Evaluation and Certification:

- Work Logbook: Throughout the internship, students will maintain a comprehensive work logbook, validated by supervisors or trainers.

- Certificate: Upon completion, students must submit their work logbook along with a certificate from the training institute verifying their participation and achievements.

- Examinations: The internship culminates in practical and viva examinations conducted by internal and external examiners appointed by the University. These evaluations assess the student's practical skills, theoretical knowledge application, and overall competency in medical laboratory technology.

BSc Medical Laboratory Technology Internship Competencies

Upon completion of their internship, students in the BSc Medical Laboratory Technology program should demonstrate the following competencies:

1. Proficiently perform a full range of clinical laboratory tests in all the fields of Medical Laboratory Technology
2. Manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information
3. Perform routine clinical laboratory testing.
4. Make specimen-oriented decisions on predetermined criteria including working knowledge of critical values.
5. Communicate with other members of healthcare team, customers, and patients in an effective manner.
6. Process information and ensure quality control as appropriate to routine laboratory procedures.
7. Upgrade knowledge and skills in a changing healthcare scenario.
8. Should know the logical interpretation of clinical lab investigations.
9. Should be able to extrapolate data acquired
10. Operate and maintain automated laboratory instruments and systems proficiently to ensure efficient and accurate performance of tests and procedures.

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