SCHEME & SYLLABUS
Masters of Medical Laboratory Science

As per NCAHP

Program Code:PG065

Department of Allied Health Sciences (UIAHS)
Sant Baba Bhag Singh University
2026

ABOUT THE DEPARTMENT

The Department of Allied Health Sciences, formerly the Department of Natural Science, was established in 2015. Over the years, the department has flourished and now offers programs at the graduate, postgraduate, and doctoral levels in Medical Laboratory Sciences (MLS), Medical Radiology & Imaging Technology (MRIT), and Anaesthesia & Operation Theatre Technology (AOTT). With modern laboratories, experienced faculty, and strong clinical collaborations, the Institute integrates scientific knowledge, practical skills, and ethical values to prepare competent healthcare professionals aligned with national and global healthcare standards.

ABOUT THE PROGRAMME:

The programme in Medical Laboratory Sciences is designed to develop skilled laboratory professionals proficient in diagnostic testing, clinical analysis, and quality assurance practices. It provides comprehensive training in biochemistry, microbiology, hematology, pathology, molecular diagnostics, and emerging laboratory technologies. Through advanced laboratory exposure and research orientation, students gain the competence required to support accurate diagnosis, disease monitoring, and evidence-based clinical decision-making.

SALIENT FEATURES OF THE DEPARTMENT:

- Strong academic framework aligned with **NCAHP guidelines** and national regulatory standards.
- Well-equipped, modern laboratories with advanced diagnostic and clinical equipment.
- Experienced and research-oriented faculty with strong academic and clinical expertise.
- Extensive hands-on training through hospital tie-ups and healthcare collaborations.
- Career-oriented programmes with strong employability prospects in the healthcare sector.
- Supportive learning environment with mentorship and academic guidance.

MMLS (Master of Medical Laboratory Science)

The Master of Medical Laboratory Science (MMLS) is specifically aimed at those pursuing a professional career in medical laboratory science. It is designed to provide specialized training both in basic scientific principles of modern laboratory science and in the application of these principles to laboratory diagnosis and management. It is designed as a higher degree program suitable for graduates having experience in Medical Laboratory Science. The program aims to enhance the scientific skills of non-medical graduates with insight into clinical problems that will allow them to work in multidisciplinary teams.

LEARNING OBJECTIVES

Upon successful completion of the Master's program, students will

1. **Demonstrate proficiency in a comprehensive range of laboratory procedures**, including advanced techniques in haematology, clinical chemistry, and microbiology.
2. **Identify and troubleshoot issues across all phases of laboratory testing**—preanalytical, analytical, and post-analytical—to ensure accuracy and reliability of results.
3. **Operate, maintain, and troubleshoot sophisticated laboratory instrumentation**, applying best practices for quality assurance and control.
4. **Interpret complex laboratory data** within the context of pathophysiology and clinical decision-making, with a sound understanding of diagnostic principles related to various organ systems.
5. **Contribute to the innovation and development of diagnostic techniques and laboratory methodologies**, supporting the advancement of evidence-based clinical practice.
6. **Demonstrate readiness for advanced roles** in healthcare, laboratory management, education, and biomedical research through enhanced critical thinking, ethical decision-making, and leadership skills.

CAREER OPPORTUNITIES

Upon successful completion of the course, post-graduates can have the following career opportunities:

Clinical labs – senior scientist, specialist, or lab manager.

Research & biotech – R&D, clinical trials, molecular diagnostics.

Academia – lecturer, trainer, or pursuing a PhD.

Public health & regulation – surveillance, quality assurance, accreditation.

Industry – medical science liaison, product specialist, lab informatics.

Global & entrepreneurial roles – international practice, diagnostic startups, or work with WHO/NGOs

PROGRAM LEARNING OUTCOMES FOR MASTER OF MEDICAL LABORATORY SCIENCE (MMLS)

The following outcomes reflect the expected competencies and professional capabilities of a graduate upon completion of the program:

1. **Advanced Laboratory Competence:** Apply advanced knowledge and technical skills in areas such as clinical chemistry, hematology, microbiology, immunology, transfusion science, molecular diagnostics, and histopathology.

2. **Critical Thinking and Problem-Solving:** Critically evaluate laboratory data, troubleshoot complex testing procedures, and apply evidence-based practices in laboratory decision-making.

3. **Research and Innovation:** Design, conduct, and interpret research studies; contribute to scientific knowledge through research dissemination and potential innovation in diagnostic techniques.

4. **Quality Management and Accreditation:** Demonstrate understanding of quality assurance systems, accreditation processes (e.g., ISO 15189), laboratory safety, and regulatory compliance in clinical laboratory operations.

5. **Leadership and Management:** Exhibit leadership, strategic planning, and effective resource management in laboratory settings; supervise personnel and contribute to operational excellence.

6. **Interdisciplinary Collaboration:** Collaborate with healthcare professionals to provide accurate diagnostic information, participate in interdisciplinary teams, and support patient-centered care.

7. **Ethical and Professional Practice:** Adhere to ethical principles, legal frameworks, and professional standards in all aspects of laboratory science and research.

8. **Communication Skills:** Effectively communicate scientific and clinical information to peers, healthcare providers, patients (where applicable), and the broader scientific community.

9. **Continuous Learning and Development:** Engage in lifelong learning and professional development to stay current with advances in medical laboratory science and emerging diagnostic technologies.

10. **Global and Societal Impact Awareness:** Understand the role of medical laboratory science in public health, global health challenges, and the social determinants of health.

EXPECTATIONS FROM FUTURE GRADUATES IN PROVIDING PATIENT CARE

Future graduates of medical laboratory science programs are expected to play an increasingly integral role in healthcare delivery. Key expectations include:

1. **Accurate and Timely Diagnostics**: Delivering high-quality laboratory results that are critical for early detection, diagnosis, prognosis, and monitoring of diseases.
2. **Interdisciplinary Collaboration**: Working closely with physicians, nurses, and other healthcare professionals to interpret lab results and support clinical decisions.
3. **Patient-Centered Focus**: Understanding the impact of laboratory findings on patient outcomes and ensuring test appropriateness, especially in personalized and precision medicine.
4. **Continual Learning**: Keeping pace with rapid advancements in diagnostics and adopting innovations that improve efficiency and accuracy.
5. **Public Health Contribution**: Supporting disease surveillance, outbreak investigations, and screening programs, especially in resource-limited settings.
6. **Ethical Practice and Leadership**: Upholding integrity, ensuring patient confidentiality, and leading initiatives in quality improvement, laboratory safety, and policy development.

ELIGIBILITY CRITERIA

1. Candidate must have passed a Bachelor of Medical Laboratory Science (B.MLS) in regular mode from a recognized University.
2. Admission to MMLS shall be made based on the university entrance exam followed by an interview. No direct Admission will be entertained.
3. Post Graduate entrance criteria required to be compulsory registered member of National Commission for Allied & Healthcare Professions (NCAHP).

DURATION

The duration of the program is 2 years or 4 semesters with 1340 hours of lecture and 900 hours of practical Training

Total number of hours: 2240
Total Credits : 86

2-year program including six months of Research Dissertation - Master's degree level

Medium of instruction: English shall be the medium of instruction for all the subjects of study and for examination of the course.

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SEMESTER-I

COMMON FOR ALL SPECIALIZATION

S .No	Sub Code	Subject Name	Lecture	Tutorial	Practical	Credits	Contact Hours
1	MMLS501	Medical Laboratory Management	4	0	0	4	60
2	MMLS503	Cell and Molecular Biology	4	0	0	4	60
3	MMLS505	Research Methodology & Biostatistics	2	0	0	2	30
4	MMLS509	Advanced Molecular Diagnostic Techniques	4	0	0	4	60
5	MMLS513	Digital Health Technologies	2	0	0	2	30
6	MMLS507	Research Methodology & Biostatistics Practical	0	0	4	2	60
7	MMLS511	Advanced Molecular Diagnostic Techniques Practical	0	0	4	2	60
8		Discipline specific elective*	0	0	4	2	60
Total			**16**		**12**	**22**	**420**

*MMLS515: Molecular Diagnostics Data Interpretation Practical (For Medical Biochemistry)

*MMLS517: Advanced Microbiological Techniques Practical (For Medical Microbiology)

Total Contact hrs: 420

Total Credit Hours:22

SEMESTER-II (Medical Biochemistry)

S .No	Sub Code	Subject Name	Lecture	Tutorial	Practical	Credits	Contact Hours
1	MMLS502	Bioorganic & Biophysical Chemistry	4	0	0	4	60
2	MMLS506	Instrumentation in Biochemistry	4	0	0	4	60
3	MMLS510	Enzymology & Nutrition	4	0	0	4	60
4	MMLS512	Intermediary Metabolism	4	0	0	4	60
5	MMLS504	Bioorganic & Biophysical Chemistry Practical	0	0	4	2	60
6	MMLS508	Instrumentation Practical	0	0	4	2	60
7	MMLS514	Clinical Posting	0	0	4	2	90
		Total	**16**	0	**12**	**22**	**450**

Total Contact Hours: 450
Total Credit Hours: 22

SEMESTER-II (Medical Microbiology)

S .No	Sub Code	Subject Name	Lecture	Tutorial	Practical	Credits	Contact Hours
1	MMLS526	Essential and Applied Microbiology	3	1	0	4	60
2	MMLS528	Systematic Bacteriology	3	1	0	4	60
3	MMLS530	Systematic Bacteriology Practical	0	0	4	2	60
4	MMLS532	Medical Entomology and Parasitology	3	1	0	4	60
5	MMLS534	Medical Entomology and Parasitology Practical	0	0	4	2	60
6	MMLS536	Immunology and Immunodiagnostics	3	1	0	4	60
7	MMLS538	Immunology and Immunodiagnostics Practical	0	0	4	2	60
Total			**12**	**4**	**12**	**22**	**420**

Total Contact Hours: 420
Total Credit Hours: 22

SEMESTER-III (Medical Biochemistry)

S .No	Sub Code	Subject Name	Lecture	Tutorial	Practical	Credits	Contact Hours
1	MMLS601	Clinical Biochemistry I	4	0	0	4	60
2	MMLS605	Clinical Biochemistry II	4	0	0	4	60
3	MMLS609	Immunology	4	0	0	4	60
4	MMLS613	Endocrinology & Biochemistry of aging	4	0	0	4	60
5	MMLS603	Clinical Biochemistry I Practical	0	0	4	2	60
6	MMLS607	Clinical Biochemistry II Practical	0	0	4	2	60
7	MMLS611	Immunology Practical	0	0	4	2	60
	Total		**16**	**0**	**12**	**22**	**420**

Total Contact hrs: 420
Total Credit Hours: 22

SEMESTER-III (Medical Microbiology)

S .No	Sub Code	Subject Name	Lecture	Tutorial	Practical	Credits	Contact Hours
1	MMLS625	Medical Virology	3	1	0	4	60
2	MMLS627	Medical Mycology	3	1	0	4	60
3	MMLS629	Medical Mycology & Virology Practical	0	0	4	2	60
4	MMLS631	Public Health Microbiology	3	1	0	4	60
5	MMLS633	Public Health Microbiology Practical	0	0	4	2	60
6	MMLS63	Advances in Microbial Informatics	3	1	0	4	60
7	MMLS65	Clinical Posting	0	0	4	2	90
Total			**12**	**4**	**12**	**22**	**450**

Total Contact Hours: 450
Total Credit Hours: 22

Semester-IV (Common for all streams)

Sr. No.	Subject Code	Subject Name	L:T:P	Credit hours	Total Contact Hours	Total Credits Hours
1	MMLS602	Dissertation	0:0:0	0:0:0	(6 months) 990 hrs	22

Total Contact hrs: 990
Total Credit Hours: 22

MARKS DISTRIBUTION

SEMESTER-I (Common for All Specializations)

S. No	Subject Name	Continuous Assessment	End Semester Examination	Total
1	Medical Laboratory Management	30	70	100
2	Cell and Molecular Biology	30	70	100
3	Research Methodology & Biostatistics	30	70	100
4	Advanced Molecular Diagnostic Techniques	30	70	100
5	Digital Health Technologies	30	70	100
6	Research Methodology & Biostatistics Practical	30	70	100
7	Advanced Molecular Diagnostic Techniques Practical	30	70	100
8	Discipline Specific Practical	30	70	100
Total				700

SEMESTER-II

Medical Biochemistry				
S. No	**Subject Name**	**Continuous Assessment**	**End Semester Examination**	**Total**
1	Bioorganic & Biophysical Chemistry	30	70	100
2	Instrumentation in Biochemistry	30	70	100
3	Enzymology & Nutrition	30	70	100
4	Intermediary Metabolism	30	70	100
5	Bioorganic & Biophysical Chemistry Practical	30	70	100
6	Instrumentation Practical	30	70	100
7	Clinical posting – log book and viva	30	70	100
Total				700
Medical Microbiology				
S. No	**Subject Name**	**Continuous Assessment**	**End Semester Examination**	**Total**
1	Essential and Applied Microbiology	30	70	100
2	Systematic Bacteriology	30	70	100
3	Medical Entomology and Parasitology	30	70	100
4	Immunology and Immunodiagnostics	30	70	100
5	Systematic Bacteriology Practical	30	70	100
6	Medical Entomology and Parasitology Practical	30	70	100
7	Immunology and Immunodiagnostics Practical	30	70	100
Total				700

SEMESTER-III

Medical Biochemistry				
S. No	**Subject Name**	**Continuous Assessment**	**End Semester Examination**	**Total**
1	Clinical Biochemistry I	30	70	100
2	Clinical Biochemistry II	30	70	100
3	Immunology	30	70	100
4	Endocrinology & Biochemistry of aging	30	70	100
5	Clinical Biochemistry I Practical	30	70	100
6	Clinical Biochemistry II Practical	30	70	100
7	Immunology Practical	30	70	100
Total				700
Medical Microbiology				
S. No	**Subject Name**	**Continuous Assessment**	**End Semester Examination**	**Total**
1	Medical Virology	30	70	100
2	Medical Mycology	30	70	100
3	Public Health Microbiology	30	70	100
4	Advances in Microbial Informatics	30	70	100
5	Medical Mycology & Virology Practical	30	70	100
6	Public Health Microbiology Practical	30	70	100
7	Clinical posting – log book and viva	30	70	100
Total				700

SEMESTER-IV (Common for All Specializations)

S. No	Subject Name	Continuous Assessment	End Semester Examination	Total
1	Dissertation viva	100	200	300
2	Dissertation Logbook	100	200	300
Total				600

Marks qualifying for a passing

For University examination subjects: 50% in internal assessment, 50% in university theory examination, 50% in university practical examination and 50% in aggregate For thesis and defence:

For successful thesis defence, the candidate will make a brief presentation of about 30 minutes followed by viva-voce. A candidate must secure at least 50% marks to pass

FIRST SEMESTER

Medical Laboratory Management

Course Code	MMLS501
Course Title	Medical Laboratory Management
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	This course will enable the student to manage resources, understand and follow GCLP, minimize errors, implement and maintain quality control measures, maintain equipment and promote a safe working environment, develop good communication skills, foster team work and develop leadership skills.
Course Outcomes (CO)	At the end of the course the student should be able to **1.** Understand the need for efficient and effective laboratory operations, including resource allocation, personnel enagement, equipment and reagent purchase and maintenance. **2.** Comprehend knowledge of relevant regulations, standards, and best practices for overall improvement of laboratory services for patient care

UNIT-I

Principles of Lab management: Financial management, human resource management and space and facility management. Organisational structure of lab. Laboratory design: functional components of laboratory, Various types of laboratory. A standardized clinical laboratory set up, Factors affecting productivity of a laboratory

Training of technical staff in Clinical laboratory: Areas of training. Role of lab supervisors in training. Job description of various levels. Hands on approach to various laboratory practices

UNIT-II

Work- Flow of a Clinical Laboratory – sample reception, registration, barcoding, centrifuging, sample processing, result checking, result release, sample storage Scope of laboratory services

UNIT-III

Good Clinical laboratory practices (GCLP)

- Standard operating procedures (SOP): importance of SOP's in a clinical laboratory
- Laboratory personnel: Role of lab personnel in a medical Laboratory
- Laboratory sample management: request form, sample labelling, sample register, sample storage, sample disposal
- Laboratory equipment: Equipment procurement and evaluation. Details of specific instruments / devices for analyte estimations (routine chemistry, hormones, tumour markers, electrolytes, drugs, metals, blood gases, amino acids,)
- Laboratory reagents and kits: Procuring kits, inventory, storage, validation

UNIT-IV

Laboratory errors: Root cause analysis and CAPA (corrective action, preventive action)

Phases of errors in clinical Laboratory testing process

- Preanalytical variables
- Analytical variables- Use of stable reference materials calibrators & controls, LJ charts and Westgard rules. Standardization / Calibration processes**:** Calibration of basic equipments by laboratory personnel. Calibration of methods colorimetric and enzymatic.
- Postanalytical variables: transfer of results, documentation, competence and various laboratory processes

UNIT-V

Total Quality management:

- Fundamental principles. TQM framework
- External Quality Assessment Schemes
- Internal QC Procedures, Use of Internal Quality Control material. Care and procedural steps in reconstitution of commercial controls.

UNIT-VI

Biological Reference Intervals: Definition. Establishment. Validation of reference intervals. Diagnostic efficacy.

Documentation in Laboratory/Maintenance of records: Patient entry registers, Procedure manuals, Registers of Reagents, consumables and accessories, quality control data, patient data and all relevant lab records

UNIT-VII

Clinical laboratory informatics: Computer basics. Word processing, spreadsheets, data-base, graphics, statistics, Laboratory Information Systems (LIS)

UNIT-VIII

Laboratory Accreditation and Audit: ISO guidelines, NABL 15189 standards, Audit in a Medical Laboratory: Introduction and Importance, Responsibility, Planning, internal audit, Horizontal, Vertical and Test audit, Frequency of audit, Documentation.
Overview of JCI & CAP.

UNIT-IX

Public relations: Interpersonal skills at work place, communication with patients, Leadership management, conduction of seminar and CME programs, performance appraisal of staff, Laboratory approach to patient community, patient/clinician feedback forms, Hospital organization and interactions between the laboratory service and the rest of the hospital

UNIT-X

Risk Management and safety measures: Safety responsibility employer and employee - Safety in a clinical laboratory: personal protection, Laboratory hazards, Laboratory safety- fire, chemical, electrical, radiation, Laboratory infection control, Hazardous waste and transport of Hazardous material, biomedical waste management, HIV: pre- and post-exposure guidelines, Hepatitis B & C: pre- and post-exposure guidelines, drug Resistant Tuberculosis, Needle prick injury and followup, Accident documentation and investigation

Text and Reference Books

S.No	Name	Author(S)	Publisher
1.	The Clinical Laboratories	MacMillan, D., & Lewandrowski, K. B	
2.	Henry's clinical diagnosis and management by laboratory methods.	Chou, D. (2007)	
3.	Tietz Textbook of Clinical Chemistry and Molecular Diagnostics-E-Book: Tietz	Rifai, N. (2017)	
4.	Textbook of Medical Laboratory Technology 2nd Edition 2022	Mrinalini Sant (2022)	
5.	Textbook of medical laboratory technology.	Godkar, P. B., & Godkar, D. P. (2006).	Bhalani

Cell and Molecular Biology

Course Code	MMLS503
Course Title	Cell and Molecular Biology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	Molecular Biology knowledge is essential for a Medical Laboratory Science scholar as it provides the foundation to the professional in understanding the latest techniques in Biotechnology. It empowers the graduate to use advanced techniques in disease diagnosis and progression and also in analyzing genetic information which explains genetic and molecular basis of many diseases affecting mankind
Course Outcomes (CO)	At the end of the course students will be able to **1.** Comprehend in-depth understanding of fundamentals. **2.** Understand and apply techniques for disease diagnosis with extreme accuracy and precision **3.** Develop research attitude that can further help in developing newer techniques in molecular Biology

UNIT-I

Basic Concept of Cell Structure, Function And Processes

a) Cell Organelles and Their Functions

b) Cell Division, Cell Cycle And Apoptosis

UNIT - II

The Central Dogma of Molecular Biology-Transfer Of Genetic Information From DNA To RNA To Protein Synthesis

- DNA Replication
- Transcription-The Process of Transcription, Inhibition of Transcription, Reverse Transcriptase, Post Transcriptional Modification
- Translation- The Process of Translation, Post Translational Modifications Like Folding, Glycosylation Etc.
- Inhibitors Of Protein Synthesis

UNIT - III

Gene Expression-Regulation and Significance

UNIT – IV

In Situ Hybridization-To Study Gene Expression Pattern, Localize Gene Amplification, Gene Location

UNIT – V

Concept Of Gene Switching, Gene Transposition, Somatic Recombination

UNIT – VI

Cell Culture: Introduction, Significance, Cell Culture Lab – Instruments, Aseptic Techniques, Media Preparation and Filteration for Cell Culture, Media Composition and Supplements, Types of Cell

Culture- Primary, Secondary. Adherent, Suspension Cells, Commonly Used Cell Lines, Cell Culture Procedure, Contamination In Cell Culture Lab, Biosafety Levels, Ethical Issues. Waste Disposal.

UNIT – VII

Basic Principles and Applications of Molecular Techniques

Recombinant DNA Technology: Restriction Endonuclease, DNA Ligase, Vectors, Chimeric Molecules, Cloning, Gene Library, Cloning Strategies, In-Situ Hybridization, Blot Techniques and Applications, RFLP, Gene Therapy, Tran Genesis, DNA Finger Printing, DNA Sequencing, PCR, DNA Probes, Hybridoma Technology.

Text and Reference Books

S.No	Name	Author(S)	Publisher
1.	Principles Of Molecular Biology	Veer Bala Rastogi (2015)	
2.	Wilson and Walker's principles and techniques of biochemistry and molecular biology.	Wilson, K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018).	Cambridge university press
3.	Biochemistry	Satyanarayana, U. (2013).	Elsevier Health Sciences.
4.	Molecular cell biology.	Lodish, H. F. (2008)	Macmillan
5.	Cell and molecular biology: concepts and experiments.	Karp, G. (2009)	John Wiley & Sons.

Research Methodology & Biostatistics

Course Code	MMLS505
Course Title	Research Methodology & Biostatistics
Type of course	Theory
LTP	2 0 0
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	This course provides students in health sciences with practical skills to design, conduct, and analyse scientific research relevant to clinical & laboratory settings.
Course Outcomes	At the end of the course, students will be able to **1.** Understand the fundamentals, types of research in health sciences, formulate research problems and hypotheses relevant to laboratory medicine. **2.** Design appropriate research studies and select suitable data collection methods **3.** Apply statistical tools for data analysis and interpretation.

UNIT-I

Introduction to Statistics and Data

- Definition and Scope of Statistics in Health Sciences
- Uses of Statistics in Clinical and Preventive Medicine
- Types of Variables:
  - Qualitative vs Quantitative
  - Discrete vs Continuous
- Scales of Measurement: Nominal, Ordinal, Interval, Ratio
- Measures of Central Tendency: Mean, Median, Mode
  - Definitions, Properties, Applications
- Measures of Dispersion:
  - Range, Quartile Deviation, Interquartile Range, Standard Deviation, Variance, Coefficient of Variation
- Quartiles and Percentiles

UNIT-II

Probability, Distributions, and Sampling

- Normal and Standard Normal Distribution: Properties and Applications
- Probability Concepts and Calculations (mean ± SD intervals)
- Skewness and Kurtosis: Definitions and Interpretation
- Parameters vs Statistics
- Population, Sample, Sampling Frame
- Sampling Distribution and Central Limit Theorem
- Standard Error: Mean, Proportion, Differences
- Confidence Intervals for Means and Proportions

UNIT-III

Hypothesis Testing and Statistical Inference

- Hypothesis Testing:

- Null and Alternative Hypotheses
- Type I and II Errors
- One-tailed vs Two-tailed Tests
- p-value, Significance Level, Power

- Parametric Tests:
  - Paired and Unpaired t-tests
  - One-way and Repeated Measures ANOVA
- Non-parametric Tests:
  - Mann-Whitney U, Wilcoxon Signed Rank, Kruskal-Wallis, Friedman's ANOVA
- Chi-square Test and McNemar's Test: Concepts and Applications

UNIT-IV

Correlation, Regression, and Advanced Analysis

- Correlation:
  - Types, Scatter Diagrams, Pearson's and Spearman's Coefficients
  - Coefficient of Determination
- Regression Analysis:
  - Simple and Multiple Linear Regression
  - Logistic Regression: Concepts and Applications
- Diagnostic Test Evaluation: Sensitivity, Specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- Receiver Operating Characteristic (ROC) Curve
- Agreement and Reliability: Bland-Altman Plot and Kappa Statistics

UNIT-V

Research Methodology and Epidemiological Applications

- Research Process and Types of Research Designs
- Data Collection Methods and Sources
- Qualitative Research and Content Analysis
- Test Construction: Reliability, Validity, Norms
- Sample Size Estimation for Means and Proportions
- Rates, Ratios, and Proportions: Definitions and Calculations
- Epidemiological Study Designs:
  - Case Reports, Case Series, Cross-sectional,
  - Case-Control, Cohort Studies
  - Confounding and Methods to Control
  - Randomized Controlled Trials (RCTs),
  - Randomization, Blinding

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Methods of Biostatistics: For Medical Student and Research work.	Mahajan, B. (2004)	Jaypee Brothers, New Delhi
2	Essentials of Research Methodology for all Physiotherapy and Allied Health Sciences Students	Ramalingam Thangamani A	
3.	Essentials of research methodology for all physiotherapy and Allied Health Sciences Students.	Ramalingam, T. A., & Kumar, S. N. (2018)	Jaypee Brothers Medical Publishers.
4	Basic & Clinical Biostatistics.	Dawson, B. and Trapp, R.G. (2001)	Lange Medical Books/ McGraw-Hill, New York.
5	Fundamentals of biostatistics (Vol. 6)	Rosner, B. A. (2006	Belmont, CA: Thomson-Brooks/Cole.
6	Statistical methods in medical research.	Armitage, P., Berry, G., & Matthews, J. N. S. (2013)	John Wiley & Sons
7	Biostatistics: A Foundation for Analysis in the Health Sciences 8th Edition	Daniel, W. W. (2004)	Wiley Series in Probability and Statistics
8	SPSS/R Software Manuals, IBM (for SPSS)	R Core Team (for R)	

Advanced Molecular Diagnostic Techniques

Course Code	MMLS509
Course Title	Advanced Molecular Diagnostic Techniques
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	This course provides students with a comprehensive understanding of the advanced molecular techniques and enable them to apply advance methods in the diagnosis
Course Outcomes	At the end of the course students should be able to: **1.** comprehend knowledge and clinical skills of molecular techniques **2.** Use accurate and advance diagnostic tools

UNIT-I

Principle & Role of Molecular Diagnostics: Basic principles in molecular diagnostics and organizations of molecular diagnostics laboratory. Role of molecular diagnostics in present diagnostic era, Ethical issues related to molecular diagnostics, future of molecular diagnostics, Historical aspects advantage of DNA over traditional serology

UNIT-II

PCR and its modifications: Principle of PCR, types of PCR: Primer designing, Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Multiplex PCR, Nested PCR, In situ PCR, Long- PCR, PCR-ELISA, arbitrarily primed PCR. Applications of PCR in Diagnosis and research.

PCR modifications: Ligase Chain Reaction, isothermal amplification, nucleic acid sequence-based amplification (NASBA), transcription mediated amplification, strand displacement amplification. Specimen collection, advantages and disadvantages of techniques, key factors affecting the performance and reliability.

UNIT-III

Quantitative and Qualitative estimations: Protein stability, denaturation; amino acid sequence analysis, Hybridization techniques – Southern, Northern, in-situ (including FISH), line probe assay, microarrays – types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot

UNIT-IV

Instruments and Techniques: Spectrophotometry, HPLC, MS, ELISA, Chemiluminescent, FIA, Flow cytometry, and specific applications; Electron microscopy and its application, Immuno-histochemistry, Immunoflourescenes, Immunocytochemistry– principle and techniques

UNIT-V

Recombinant DNA technology: Restriction endonuclease, DNA ligase, vectors, chimeric molecules, cloning, gene library, cloning stratagies, and applications, RFLP, Gene therapy, Trangenesis, DNA finger printing, DNA probes, hybridoma technology

UNIT-VI

Definition, application and advantages of Genomics, Next- generation sequencing technology, Proteomics, Transcriptomics, Metabolomic.

Text and Reference Books

S.No	Name	Author(S)	Publisher
1.	Wilson and Walker's principles and techniques of biochemistry and molecular biology.	Wilson, K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018).	Cambridge university press.
2	Textbook of medical laboratory technology	Godkar, P. B., & Godkar, D. P. (2006)	Bhalani publishing house
3	Molecular biology techniques: a classroom laboratory manual	Carson, S., Miller, H. B., Srougi, M. C., & Witherow, D. S. (2019)	Academic Press.
4	Techniques for molecular biology	Tagu, D., & Moussard, C. (Eds.). (2006).	Science Publishers
5	Molecular diagnostics: for the clinical laboratorian	Coleman, W. B., & Tsongalis, G. J. (Eds.). (2007)	Springer Science & Business Media.
6	Recombinant DNA principles and methodologies	Greene, J. (Ed.). (1998)	CRC Press.

Digital Health Technologies

Course Code	MMLS513
Course Title	Digital Health Technologies
Type of course	Theory
LTP	2 0 0
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	This course aims to equip students with foundational knowledge and practical insights into the application of digital health technologies in the medical laboratory setting. Understanding the course will make students competent in understanding and integrating these technologies essential to enhance diagnostics, quality assurance, data management, and patient care.
Course Outcomes	At the end of the course the student should be able to: **1.** Understand digital technologies shaping medical laboratory practices. **2.** Apply digital tools for laboratory data management and quality control. **3.** Explore AI and machine learning in laboratory diagnostics. **4.** Assess the role of telehealth and remote diagnostics in laboratory medicine. **5.** Evaluate digital health standards, data security, and regulatory considerations.

UNIT-I

Introduction to Digital Health in Laboratory Medicine: Definition and scope of digital health, Evolution and historical perspectives, Current healthcare, big data, and machine learning, artificial intelligence in healthcare applications, predictive analytics in healthcare, WHO classification of digital health interventions

UNIT-II

Artificial Intelligence and Machine Learning in Diagnostics: AI in hematology: automated WBC differential, RBC morphology.

AI in histopathology and cytopathology: image classification and tumor grading

AI in microbiology: colony morphology analysis, resistance prediction

AI in biochemistry: predictive analytics from lab trends (e.g., sepsis prediction

AI in molecular diagnostics: variant classification and pathogenicity prediction, Digital Epidemiology and Health Surveillance

UNIT- III

Telehealth medicine: Definitions and distinctions: Telehealth vs. Telemedicine vs. Remote Patient Monitoring, trends in telemedicine, Types of telehealth modalities: synchronous, asynchronous, and hybrid, Components of a telehealth ecosystem (software, devices, connectivity, data platforms), Role of laboratory medicine in remote monitoring (e.g., chronic disease management), AI Applications in Remote Patient Monitoring, Mobile Health (mHealth) and Health Apps

UNIT- IV

Digital Health: Definition and scope of digital health, Key stakeholders: healthcare providers, patients, policymakers, IT developers, Global and national digital health strategies (e.g., WHO Digital Health Strategy, NDHM India), Digital health ethics and data governance, lectronic Health Records (EHR) and

Laboratory Information Systems (LIS), Structure and function of EHR systems, Data security and patient confidentiality, Clinical decision support systems (CDSS) integration with LIS, Case studies on digitized lab workflows

UNIT- V

Ethical and legal challenges of artificial intelligence-driven healthcare: Regulatory classification of AI-powered RPM devices (e.g., FDA SaMD, CDSCO), Requirements for clinical validation and safety assessment,

Ethical considerations in autonomous health monitoring, Challenges of algorithmic bias and AI transparency, Legal responsibility in automated decision-making

Text and Reference Books

S.No	Name	Author(S)	Publisher
1.	Deep medicine: how artificial intelligence can make healthcare human again	Topol, E. (2019)	Hachette UK
2	Artificial intelligence in healthcare	Bohr, A., & Memarzadeh, K. (Eds.). (2020)	Academic Press
3	Classification of digital interventions, services and applications in health: a shared language to describe the uses of digital technology for health	World Health Organization. (2023)	World Health Organization.
4	Handbook of artificial intelligence in Healthcare	C. P., Vaidya, A., Jain, K., Mahorkar, V. U., & Jain, L. C. (2022)	Springer International Publishing

Research Methodology & Biostatistics Practical

Course Code	MMLS507
Course Title	Research Methodology & Biostatistics Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	This course provides students in health sciences with practical skills to design, conduct, and analyse scientific research relevant to clinical & laboratory settings.
Course Outcomes	At the end of the course, students will be able to **1.** Understand the fundamentals, types of research in health sciences, formulate research problems and hypotheses relevant to laboratory medicine. **2.** Design appropriate research studies and select suitable data collection methods **3.** Apply statistical tools for data analysis and interpretation.

LIST OF PRACTICALS

1. **Data Handling & Descriptive Statistics**
   a. Collect raw data from a lab or clinical setting.
   b. Classify variables (qualitative/quantitative, discrete/continuous).
   c. Organize data into frequency tables.
   d. Calculate and interpret: Mean, median, mode
   e. Range, standard deviation, variance
   f. Create visual representations: Bar charts, histograms, pie charts, box plots

2. Probability & Distributions
   a. Plot and interpret normal distribution curves.
   b. Calculate probabilities using mean ± 1SD, 2SD, 3SD.
   c. Identify skewness and kurtosis from datasets.

3. Sampling & Estimation
   a. Demonstrate random sampling techniques (simple, stratified, cluster).
   b. Calculate standard error and confidence intervals.
   c. Estimate population parameters from sample data

4. Hypothesis Testing: Perform and interpret:
   a. One-sample and two-sample t-tests
   b. Paired t-test
   c. Chi-square test (2x2 table)
   d. ANOVA (one-way)
   e. Use SPSS/R to run tests and interpret outputs.

Advanced Molecular Diagnostic Techniques Practical

Course Code	MMLS511
Course Title	Advanced Molecular Diagnostic Techniques Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	Students will gain practical skills necessary for various laboratory techniques required for the molecular diagnosis
Course Outcomes	At the end of the course students should be able to: **1.** comprehend knowledge and clinical skills of molecular techniques **2.** Use accurate and advance diagnostic tools

LIST OF PRACTICALS

1. DNA Isolation
2. RNA Isolation
3. Polymerase chain reaction
4. PAGE
5. ELISA
6. Demonstration of western blot
7. HPLC
8. Spectrophotometer analysis- protein Analysis
9. Immunohistochemistry
10. Demonstration of electron microscope

Note: Clinical laboratory rotation/observation can be incorporated wherever possible

Text and Reference Books

S.No	Name	Author(S)	Publisher
1.	Textbook of medical laboratory technology	Godkar, P. B., & Godkar, D. P. (2006)	Bhalani publishing house
2	Molecular biology techniques: a classroom laboratory manual	Carson, S., Miller, H. B., Srougi, M. C., & Witherow, D. S. (2019)	Academic Press.
3	Molecular diagnostics: for the clinical laboratorian	Coleman, W. B., & Tsongalis, G. J. (Eds.). (2007)	Springer Science & Business Media.

Molecular Diagnostics Data Interpretation Practical

Course Code	MMLS515
Course Title	Molecular Diagnostics Data Interpretation Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	The aim of this course is to enable the students to: Interpret and analyze molecular diagnostic data from PCR, qPCR, electrophoresis, sequencing, and mutation analysis techniques to support clinical diagnosis and laboratory reporting while adhering to quality assurance standards.
Course Outcomes	At the conclusion of the course, the students will: 1. Analyze and interpret molecular diagnostic data generated through PCR, qPCR, electrophoresis, and sequencing techniques. 2. Identify genetic variations and assess their clinical significance. 3. Prepare and communicate standardized molecular diagnostic reports. 4. Apply quality assurance principles in molecular diagnostic laboratories. 5. Integrate laboratory findings with clinical information for evidence-based decision-making.

LIST OF PRACTICALS

1. **Interpretation of Conventional PCR Results**
   Analysis of amplification outcomes and identification of positive, negative, and inconclusive results.

2. **Analysis and Documentation of Gel Electrophoresis Profiles**
   Evaluation of DNA/RNA band patterns, molecular weight determination, and preparation of electrophoretic reports.

3. **Quantitative Real-Time PCR (qPCR) Data Analysis**
   Interpretation of amplification plots, threshold cycle (Ct) values, melting curves, and relative gene expression data.

4. **Mutation Detection and Variant Analysis**
   Identification and interpretation of genetic mutations, single nucleotide polymorphisms (SNPs), and clinically relevant sequence variations using molecular datasets.

5. **Molecular Diagnostic Report Preparation**
   Development of standardized laboratory reports based on PCR, qPCR, and sequencing results.

6. **Analysis of DNA Sequencing Data**
   Interpretation of chromatograms and identification of nucleotide variations using sequence analysis software.

7. **Primer Design and Validation**
   Designing primers for specific target genes and evaluating primer specificity and efficiency using bioinformatics tools.

8. **Clinical Case-Based Interpretation of Molecular Diagnostic Findings**
   Correlation of molecular test results with patient history, clinical presentation, and disease diagnosis.

9. **Quality Assurance in Molecular Diagnostic Testing**
   Identification of sources of analytical errors, validation of results, and implementation of quality control measures.

10. **Integrated Molecular Data Interpretation and Presentation**
    Compilation, analysis, and presentation of molecular diagnostic data through case studies and laboratory seminars.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Molecular Diagnostics: Fundamentals, Methods and Clinical Application, 3rd Ed	Buckingham L	1. F.A. Davis.
2	Molecular Diagnostics for the Clinical Laboratorian, 3rd Ed.,	Coleman WB, Tsongalis GJ.	Humana Press.
3	Henry's Clinical Diagnosis and Management by Laboratory Methods, 25th Ed.,	McPherson RA, Pincus MR.	Elsevier
4	Genomes, 5th Ed.	Brown TA.	1. Garland Science.
5.	Molecular Pathology in Clinical Practice, 3rd Ed., .	Leonard DGB	Springer
6.	Molecular Microbiology: Diagnostic Principles and Practice, 3rd Ed.,	Persing DH et al.	ASM Press

Advanced Microbiological Techniques Practical

Course Code	MMLS517
Course Title	Advanced Microbiological Techniques Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	The aim of this course is to enable the students to: 1. Impart the practical knowledge of different procedures for processing and identification of various bacteria using different techniques. 2. Proficiently perform full range of microbiological laboratory investigations.
Course Outcomes	At the conclusion of the course, the students will: 1) Demonstrate the different morphological types of bacteria aided by different staining (Simple, differential & special) techniques. 2) Able to prepare different type of media to cultivate organisms. 3) Know the effect of nutritional & environmental factors on microbial growth

LIST OF PRACTICALS

1. Advanced Laboratory Safety and Quality Management

a. Biosafety Levels (BSL-1 to BSL-3): Design and practices
b. Risk assessment in microbiology laboratories
c. Validation and verification of microbiological procedures
d. Internal Quality Control (IQC) and External Quality Assurance (EQAS)

2. Advanced Culture and Identification

a. Preparation of enriched, selective and differential media
b. Isolation of fastidious organisms
c. Anaerobic culture techniques
d. Identification of clinically important Gram-positive bacteria and Gram-negative bacteria
e. Identification of non-fermenters
f. Preservation of microbial cultures (cryopreservation, lyophilization)

3. Advanced Biochemical Identification

a. IMViC reactions
b. Oxidase, catalase and coagulase tests
c. Triple Sugar Iron (TSI)
d. Nitrate reduction
e. Oxidation–Fermentation test

4. Molecular Microbiology

a. Conventional PCR
b. Multiplex PCR
c. Real-Time PCR (qPCR)
d. Interpretation of PCR reports
e. Molecular detection of antimicrobial resistance genes

5. Antimicrobial Susceptibility Testing (AST)

a. Kirby–Bauer disc diffusion
b. MIC determination by broth dilution
c. E-test method
d. Detection of ESBL-producing organisms
e. Detection of carbapenemase-producing organisms
f. Detection of MRSA and VRE
g. Colistin susceptibility testing
h. CLSI/EUCAST interpretation of AST reports

6. Infection Control and Hospital Microbiology

a. Air sampling techniques
b. Surface swab culture
c. Water quality microbiology
d. Hand hygiene surveillance

SECOND SEMESTER

Bioorganic & Biophysical Chemistry

Course Code	MMLS502
Course Title	Bioorganic & Biophysical Chemistry
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective(CO)	Students will gain comprehensive understanding of biomolecular structure, function, and physicochemical perspective. This course is designed for postgraduate students to explore the principles underlying biological systems and processes.
Course Outcome	At the end of the course, students should be able to: **1.** Describe the structure-function relationships in biomolecules using principles of organic and physical chemistry. **2.** Comprehend knowledge of properties of biological fluid **3.** Understand biochemical reactions and molecular interactions.

UNIT-I

Carbohydrates: Definition, Biological importance and Classification of Carbohydrates.

Monosaccharides: Classification, Structure and Biological importance of Monosaccharides, Important chemical reactions of Monosaccharides.General Properties in reference to glucose –Structural and Stereo isomerism (Fischer and Haworth Projection formulae), Cyclic structure, Epimers, Anomers and Mutarotation.

Disaccharides: Structure, Occurrence and Biological importance of Sucrose, Lactose and Maltose.
Polysaccharides: Classification, Structure, Occurrence and Biological functions.
Homopolysaccharides & Heteropolysaccharides
Carbohydrates in cell membrane

UNIT II

Lipids: Definition, Biological importance and Classification of lipids.
Simple Lipids: fats and wax; physical and chemical properties of fats.
Identification of fats and oils: Saponification, Acetyl number, Rancidity of fats, Reichert Meissel number.
Compound lipids - Structure and Biological function of phospholipids, Glycolipids and other compound lipids – lipoproteins.
Derived lipids - Fatty acids: Structure, Classifications and Properties. Steroid and Sterols - Special reference to cholesterol -Structure, Function and Properties of Cholesterol, Other sterols of biological importance- Bile acids and vitamin D.

UNIT III

Amino acids and Proteins: Definition**,** Biological importance of proteins, composition of proteins.
Amino Acids: Definition, structure of amino acids, Classification, physicochemical properties and reactions of amino acids, Amino acids as ampholytes, Significance of non standard amino acids.

Proteins: Classification based on nutritional value, biological importance and solubility. general properties of proteins, colour reactions of proteins (end group analysis);

Structural organisation of protein: Primary structure, Peptide linkage- Structure and significance of peptide bond, amino acid sequencing (Sanger's and Edman methods). Secondary structure (helix and pleated sheets eg.Collagen), Tertiary structure of proteins (eg. Myoglobin), Quaternary structures of proteins (eg. Hemoglobin), motifs and domains, Structure function relation of protein.
Denaturation, renaturation, separation techniques

UNIT IV

Enzymes: Definition, Classification, Mechanism of Action, Models of enzyme – substrate complex formation (lock and key model, induced fit model, substrate strain theory), Enzyme specificity, Factors affecting enzyme activity

UNIT- V

Nucleic Acids and Nucleoproteins: Structure of Purines and Pyrimidines, Structure of Nucleosides and nucleotides; nucleotides and nucleosides of biological importance.

Nucleic Acids: Definition, Structure of DNA, RNA and types of RNA. DNA – Watson & Crick Model, A, B and Z forms of DNA.Properties of DNA - buoyant, density, viscosity, chromic effect, Tm, denaturation, renaturation, hybridization and Cotanalysis

UNIT- VI

Acids, Bases, Buffers in biological system, -pHHenderson Hasselbalch equation, Acid load in the body, regulation of acid base balance in body

UNIT VII

Fluid and electrolyte balance: Distribution of fluids in body, Water metabolism, Factor influencing the distribution of body water, thirst mechanism, Intake and loss of body water, Electrolyte distribution, regulation, and their functions, water/electrolyte balance.

UNIT VIII

Body Fluid properties:

Osmosis and Osmotic pressure-Osmolality of body fluids. Surface tension and viscosity their application to the human body in relation to normal life and disease processes.
Colloidal system – protective action. emulsification - colloidal systems of biological importance - their application and role in the human body.
Diffusion and absorption mechanisms - their application to biological systems.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Lehninger Principles of Biochemistry,	David L. Nelson & Michael M. Cox	W.H. Freeman
2	Harper's Illustrated Biochemistry, Edition. 31st .	Victor W. Rodwell et al.,	McGraw Hill / Medical ·
3	Textbook of Biochemistry, 9th edition	D.M. Vasudevan	Jaypee
4	Essentials of Biophysical Chemistry	R. R. Dasgupta	
5.	Principles of Physical Biochemistry	van Holde, Johnson, Ho	Pearson Education Limited
6.	Principles of Biochemistry	Voet, Voet & Pratt	,Global edition.5th edition.wile
7.	Biochemistry	U. Sathyanarayana	Elsevier
8.	Fundamentals of Biochemistry,	A.C. Deb	New Central Book Agency

Instrumentation in Biochemistry

Course Code	MMLS506
Course Title	Instrumentation in Biochemistry
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	The students will have an understanding of the principles, instrumentation and applications of various non-analytical and analytical instrumentation in a clinical laboratory.
Course Outcomes	By the end of this course, students will be able to **1.** Understand the fundamental principles behind major analytical and Non analytical instruments in clinical Laboratory **2.** Operate laboratory instruments with attention to Maintenance and calibration, sensitivity, and reproducibility. **3.** Evaluate the advantages, limitations, and applications of each technique in a diagnostic lab or research Lab

UNIT-I

Non -analytical Instrumentation: Use, calibration and their maintenance – Glass Pipettes and Micropipettes, Weighing balance (analytical and top loading digital), pH meter, Centrifuges, Water bath, hot plate, magnetic stirrer, thermometers, distilled water systems

UNIT -II

Centrifugation techniques: Definition, Basic Principles of sedimentation, instrumentation, application in clinical and research laboratory.

Types of centrifugation: Preparative, analytical centrifugation, differential centrifugation, Density gradient centrifugation , ultra centrifuge

UNIT - III

Photometry: Definition, basic Principles of photometry, functions, Beer lamberts law, Instrumentation, applications. Laws of light absorption – visible and UV Spectrophotometry

Types of Photometric Techniques: Colorimetry, and spectrophotometry, Flame photometry, Flourimetry, Spectrofluorometry, Atomic absorption spectrometry, Infra red spectrometry

UNIT-IV

Chromatography: Definition, basic principles of adsorption and partition, Instrumentation, applications in clinical and research laboratory.

Types of chromatographic techniques: Paper (one dimensional & two Dimensional) thin layer, column, affinity, gel filtration (Types of resins, gel and apparatus preparation), ion exchange, gas liquid, HPLC

UNIT-V

Clinical Chemistry analysers: Basic principles, instrumentation, function, significance of these analsyers. Types of chemistry analysers – semi –automated andFully automated

UNIT-VI

Electrophoresis: Definition, Basic Principles of electrophoresis, Instrumentation, applications. Types of electrophoretic techniques- Paper, cellulose acetate, agarose gel, PAGE , capillary, Iso electric focussing and Two dimensional gel electrophoresis.

UNIT- VII

Advance Instruments: Principles, instrumentation, techniques, and applications of Electron spin resonance, Nuclear Magnetic resonance, crystallography, Mass spectrometry

UNIT- VIII

Immunochemical techniques: Basic concepts, function and significance of these Immunoassay analysers, antigen–antibody binding quantitative methods. Types of assays- sandwich assay, competitive, non-competitive assay. TechniquesELISA (Enzyme linked immunosorbent assay), FIA, Immunoprecipitation, Turbidometry, Immunofluorescence, Chemiluminescense , Electrochemiluminescense

UNIT- IX

Osmometry : Defnition, principle of osmometry, Instrumentation, applications

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Principles and Techniques of Biochemistry and Molecular Biology	Keith Wilson & John Walker	Cambridge University Press
2	Instrumental Methods of Analysis	B.K. Sharma	Krishna Prakashan Media (p) Ltd
3	Analytical Biochemistry	David Holme & Hazel Peck	Prentice Hall
4.	Introduction to Instrumental Analysis	Robert Braun	PharmaMed Press/BSP Books
5.	Clinical Biochemistry: Metabolic and Clinical Aspects	William J. Marshall, Márta Lapsley et al.	Churchill Livingstone
6.	Principles and techniques of Biochemistry & Molecular Biology	Mahalakshmi & Senthil Kumar	Cambridge Univ. Press

Enzymology & Nutrition

Course Code	MMLS510
Course Title	Enzymology & Nutrition
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objectives	Students will gain in depth knowledge of mechanistic, regulatory roles of enzymes and the biochemical importance of macro- and micronutrients in health and disease
Course Outcome	By the end of this course, students will be able to **1.** Explain the structure, function, and classification of enzymes. **2.** Interpret enzyme kinetics, Differentiate types of enzyme inhibition and mechanism of action of enzymes **3.** Describe the functions, sources, and deficiencies of essential vitamins and minerals. **4.** Understand the role of nutrition in energy metabolism, growth, immune function, and disease prevention

UNIT-I

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group, activators, inhibitors, active site, metalloenzymes, isozymes, monomeric enzymes, oligomeric enzymes and multienzyme complexes, Units of enzyme activity (definition of IU, Katal), specific activity of enzyme, measurement of enzyme activity, enzyme turnover.

UNIT-II

Mechanism of Enzyme Action: Nature of active site, identification of functional groups at active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes: Proximity and orientation, Covalent catalysis, Acid base catalysis, Strain and distortion theory, Induced fit hypothesis, Reversible and irreversible covalent modification, feedback inhibition, control of enzyme by products, substrates and adenylate energy charge, monocyclic and multicyclic cascade systems

UNIT-III

Enzyme Kinetics: Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of Km and Vmax values, Substrate inhibition and activation, Effect of pH and temperature on rate of enzyme catalyzed reactions, Allosteric enzymes

UNIT-IV

Enzyme inhibition: reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition, Mechanism of enzymic action - general acid base catalysis, covalent catalysis, role of metal ion in enzyme catalysis, Reversible inhibition - competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition, Irreversible inhibition.

UNIT-V

Application of Enzymes: Enzymes as analytical reagents, Immobilized enzymes, Biotechnological applications of enzymes, Application of enzymes in medicine and industry

UNIT-VI

Clinical enzymology: Enzymes as thromblytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Enzymes and isoenzymes in diagnosis, Principles of diagnostic enzymology, clinical significance of alkaline and acid phosphatase, SGOT, SGPT, LDH, CPK, aspartate aminotransferase, alanine aminotransferase, creatine kinase

UNIT-VII

Nutrition: Caloric values of foods, BMR, respiratory quotient, energy requirements, role of carbohydrates, lipids, proteins and amino acids in diet, nitrogen balance, protein energy malnutrition, glycemic index, planning of diet in pregnancy and lactation, Renal Failure, cardiovascular Disease, diabetes, obesity, Cancer. Nutritional Assessment.

UNIT- VIII

Vitamins: Definition, Classification, Chemistry, Sources, biochemical functions, deficiency and toxicity manifestations of fat-soluble and water-soluble vitamins.

UNIT- IX

Minerals: Definition, Classification, Chemistry, Sources, biochemical functions, deficiency and toxicity manifestations of macro and micro minerals

UNIT- X

Nutritional Genomics: Introduction to nutrigenetics and Nutrigenomics, role of genes in metabolism and nutrient utilization, omics technologies in nutrigenomics.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Fundamentals of Enzymology	Nicholas C. Price & Lewis Stevens	Oxford university press
2	Enzymes: Biochemistry, Biotechnology, Clinical Chemistry	Trevor Palmer	*Horwood Pub*
3	Textbook of Biochemistry with Clinical Correlations	Thomas M. Devlin	wiley
4	Modern Nutrition in Health and Disease	A. Catherine Ross et al., Wolters Kluwer	Health Adis (ESP)

Intermediary Metabolism

Course Code	MMLS512
Course Title	Intermediary Metabolism
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objective	This course provides students with in-depth understanding of metabolic pathways, their interconnections, and the regulatory mechanisms that govern them in various physiological and pathological conditions.
Course Outcome	By the end of the course, students will be able to **1.** Explain the biochemical pathways of carbohydrate, lipid, amino acid, and nucleotide metabolism, including their key enzymes and intermediates. **2.** Describe the integration of metabolic pathways in various tissues. **3.** Analyze the role of regulatory molecules, cofactors, and hormones in modulating metabolic pathways.

UNIT I

Metabolism: Bioenergetics, free energy, biological oxidations, electron transport, oxidative phosphorylation.

UNIT II

Carbohydrate metabolism: Digestion and absorption, Glycolysis, gluconeogenesis, Uronic acid pathway, TCA cycle, HMP pathway, glycogen metabolism, galactose metabolism, fructose metabolism, Regulation of blood glucose.

Disorders of carbohydrate metabolism: Diabetes mellitus and its types, glycosuria and its types, Glycated proteins, urinary albumin excretion, Inborn errors of carbohydrate metabolism.

UNIT III

Amino acid and protein metabolism: Digestion and absorption Transamination, deamination - oxidative deamination and non oxidative, ammonia transport, urea formation. Metabolism of individual amino acid. Biosynthesis of catacholamines, melanin formation, Nitrogen balance.

Disorders of Protein and amino acid metabolis: Inherited disorders associated with urea cycle, proteinuria, proteinemia, Inborn error of amino acid metabolism.

UNIT IV

Lipid metabolism: Fatty acid synthesis, fatty acid oxidation, ketogenesis. Metabolism of triglycerides, phospholipids, sphingolipids, lipoproteins and cholesterol.

Disorders of lipid metabolism: Dyslipidemia, hyperlipoproteinemias, obesity, fatty liver, lipotropic factors and ketosis, atherosclerosis and coronary heart diseases**.**

UNIT V

Purine and Pyrimidine metabolism: Biosynthesis of purine and pyrimidine. Degradation of purine and pyrimidine and their Disorders.

UNIT VI

Hemoglobin metabolism: Heme synthesis, formation of hemoglobin, Structure of hemoglobin, Metabolism of bilirubin.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Lehninger Principles of Biochemistry,	David L. Nelson & Michael M. Cox	W.H. Freeman
2.	Harper's Illustrated Biochemistry, Edition. 31st .	Victor W. Rodwell et al.,	McGraw Hill / Medical ·
3.	Principles of Biochemistry	Voet, Voet & Pratt	Global edition.5th edition.wile
4.	Biochemistry	Jeremy M. Berg, John L. Tymoczko, Lubert Stry	W. H. Freeman / Palgrave Macmillan.
5.	Textbook of Biochemistry for Medical Students, 9th Edition.	D.M.Vasudevan	*Jaypee Brothers Medical*

Bioorganic & Biophysical Chemistry Practical

Course Code	MMLS504
Course Title	Bioorganic & Biophysical Chemistry Practical
Type of course	CC
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objective	Students will gain practical skills with experimental techniques that are fundamental to understanding the chemical and physical principles governing biomolecular structure, function, and interactions.
Course Outcome	By the end of this course, students will be able to **1.** Perform qualitative tests for identification and characterization of carbohydrates, and interpret the biochemical basis of the observed reaction. **2.** Demonstrate precipitation and color reactions of proteins and correlate the results with protein structure and composition. **3.** Conduct qualitative analysis of lipids using standard biochemical tests and distinguish between different lipid properties. **4.** Analyze nucleic acids through qualitative reactions and quantitative estimation techniques, including UV spectrophotometry. **5.** Prepare buffer solutions, determine pH, and explain the significance of buffers in biological systems. **6.** Demonstrate the principles of viscosity, osmosis, and diffusion using laboratory instruments and semi-permeable membranes.

LIST OF PRACTICALS

1. **Reactions of Carbohydrates** – Molisch, Iodine, Benedict, Modified Barfoed, Osazone, seliwannof, Foulger, Mucic acid, Bial

2. **Reactions of Proteins**
    a. Precipitation reactions – Acid, Base, Alcohol, Iso-electric, Half & Full saturation
    b. Colour reactions – Biuret, Ninhydrin, Hellers, Aldehyde, Paulis, Sakaguchi, Sulphur, Xanthoproteic, Millons,
3. **Reactions of Lipids** – Solubility Test, saponification test, bromine water test for unsaturated fatty acids, Acrolein test

4. **Reaction of Nucleic acid** – Dische test, Bial Test, Phosphate Test, Quantitative estimation via UV absorption at 260nm or Nano spectrophotometer

5. **Preparation of buffer and determination of pH**

6. **Demonstration**
    a. Determination of viscosity using Ostwald's viscometer.
    b. Demonstration of osmosis and diffusion using semi-permeable membranes

NOTE:- Clinical Laboratory rotation/observation can be incorporated wherever possible

Instrumentation Practical

Course Code	MMLS508
Course Title	Instrumentation Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objective	Students will be able to gain conceptual understanding and technical application of instruments. They will also gain practical skills in sample preparation, instrument handling, maintenance, troubleshooting, Quality practices,and data acquisition of instrumentation which are vital for professional laboratory work.
Course Outcome	At the end of the course, students should be able to **1.** Calibrate micropipettes and glass pipettes and apply accurate liquid handling techniques in biochemical laboratory procedures. **2.** Perform one-dimensional and two-dimensional paper chromatography for separation and identification of biomolecules. **3.** Demonstrate the principles and applications of High-Performance Liquid Chromatography (HPLC) in biochemical analysis. **4.** Conduct electrophoretic separation of biomolecules using gel electrophoresis, PAGE, and serum protein electrophoresis techniques. **5.** Quantify serum protein fractions and interpret electrophoretic patterns for diagnostic applications. **6.** Operate an osmometer and explain the significance of osmotic pressure in biological systems. **7.** Perform immunoassay techniques such as ELISA and FIA for detection and quantification of biological analytes.

LIST OF PRACTICALS

1. Calibration of micropipettes and glass pipettes
2. Paper Chromatography- One dimensional
3. Paper chromatography - Two dimensional
4. HPLC
5. Electrophoresis
    a. Gel Electrophoresis
    b. PAGE
    c. Serum protein electrophoresis and Quantification
6. Osmometer
7. ELISA/FIA

NOTE:- Clinical Laboratory rotation/observation can be incorporated wherever possible

Essential and Applied Microbiology

Course Code	MMLS526
Course Title	Essential and Applied Microbiology
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective(CO)	This course lays the foundation for comprehending genetic continuity, variability, and expression, as well as the molecular basis of mutation and repair mechanisms. It introduces students to biotechnological applications, microbial strain development, and industrial-scale cultivation techniques. It elaborates gene transfer mechanisms, plasmid biology, and their applications in genetic engineering, offering insight into innovations in medicine. It emphasises the different methods of measurement of growth along with a comprehensive description of environmental and ecological factors that influence growth dynamics and microbial behaviour in natural systems. This course also establishes a link between microbes and different environments such as soil, water and food.
Course Outcome	At the end of the course, students should be able to: **1.** Discuss the mechanisms and patterns of DNA replication. **2.** Describe major applications of recombinant DNA technology, including genetically engineered proteins and vaccines. **3.** Apply techniques to measure microbial growth in terms of cell number, mass, and activity. **4.** Analyse how environmental factors (pH, temperature, radiation, oxygen, solutes) affect microbial growth **5.** Relate microbial indicators to disease prevention and water safety management. **6.** Evaluate the ecological and health-related significance of soil microorganisms. **7.** Explain the mechanisms of microbial food spoilage and control strategies. **8.** Assess the environmental and societal impacts of microbial biotechnology.

UNIT-I

Bioreactors and Fermenters – Principles and Sterilisation Techniques- Definitions and distinctions: bioreactor vs. fermentor, Types of systems: batch, fed-batch, continuous, anaerobic and aerobic setups. Overview of usage: pharmaceutical, food, environmental, and biotechnological applications; Cultivation of bacteria, fungi, and recombinant strains, Fermentation of specialty compounds (e.g. amino acids, organic acids); Role of bioreactors/fermentors in BSL-1 to BSL-3 workflows

UNIT II

Sterilisation Techniques: Importance in contamination control and safety, Methods: autoclaving, filtration, chemical sterilant, UV/radiation, Sterilisation of air, media, vessels, and inoculum transfer zones, Validation tools: biological indicators, F_0 value, D-value, and cycle qualification. Role of bioreactors/fermentors in BSL-1 to BSL-3 workflows

UNIT III

Industrial Microbiology and Biotechnology Choosing microorganisms for industrial Microbiology and Biotechnology

- Finding microorganisms in nature
- Genetic Manipulation of Microorganisms
- Preservation of Microorganisms

Microorganisms Growth in Controlled Environments:

- Medium Development
- Growth of microorganisms in an industrial setting

Major microbial products of Industrial Microbiology:

- Antibiotics, Amino acids, Vitamins, Speciality compounds for use in medicine and Health,

Biotechnological Applications:

- Biosensors, Microarrays

Impacts of Microbial Biotechnology

UNIT IV

Bacterial Recombination: General Principles

Bacterial Plasmids: Fertility factors, Resistance factors, Col plasmids, Other types of plasmids
Applications of Genetic Engineering: Medical Applications, Production of genetically engineered Somatotrophin, Other mammalian proteins and products, Genetically engineered vaccines, Engineering metabolic pathways

Gene therapy in Humans
Social impact of Recombinant DNA technology

UNIT- V

Measurement of Microbial Growth: Measurement of cell numbers (Haemocytometer, Electronic Counters, Plating Techniques, Membrane filters) Measurement of cell mass (Turbidity measurements, Wet weight, dry weight measurements) Measurement of cell activity

The influence of environmental factors on growth: Solutes and water activity, pH, Temperature, Oxygen concentration, Pressure, Radiation

Microbial interactions: Mutualism, Protocoperation, Commensalism, Predation, Amensalism, Competition, Symbioses in complex ecosystems

Growth Limitation in natural environments: Growth limitation by Environmental factors, Counting viable but non-culturable (VBNC) vegetative prokaryotes, Quorum sensing and microbial populations, Biofilms

UNIT- VI

Waters and Disease transmission:

- Waterborne pathogens and water purification
- Sanitary analysis of waters

Wastewater treatment:

- Measuring water quality
- Waste treatment processes

UNIT VII

Soil as an Environment for microorganisms Microorganisms in the soil environment Soil Microorganisms and Human Health Understanding microbial diversity in the soil

UNIT VIII

Microorganism Growth in foods: Intrinsic factors, Extrinsic factors

Microbial Growth and Food Spoilage

Controlling Food Spoilage: Removal of microorganisms, Low Temperature, High Temperature, Water availability, Chemical-based preservation, Radiation, Microbial product-based inhibition

Detection of Food borne Pathogens

Microorganisms as food and food amendments

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Prescott	Lansing M. Prescott –	McGraw-Hill
2	Brock Biology of Microorganisms,	Michael T. Madigan	Benjamin Cummings, Pearson
3	Textbook of Microbiology	R. Ananthanarayan & C.K. Jayaram Paniker	Universities Press
4	Microbiology	Michael J. Pelczar, E.C.S. Chan, Noel R. Krieg –	McGraw-Hill
5.	Principles of Fermentation 3rd edition	Peter F. Stanbury, Allan Whitaker, Stephen J. Hall,	Butterworth-Heinemann (Elsevier)
6.	Bioprocess Engineering: Systems, Equipment and Facilities	J. Cassells	Wiley India Pvt
7.	WHO Technical Report Series on Bioprocess Containment, various volumes including TRS No. 999 and TRS No. 1033	World Health Organisation (WHO)	WHO Publications
8.	Biosafety in Microbiological and Biomedical Laboratories (BMBL), 6th Edition,	Centres for Disease Control and Prevention (CDC) & National Institutes of Health (NIH	U.S. Department of Health and Human Services, 2020

Systematic Bacteriology

Course Code	MMLS528
Course Title	Systematic Bacteriology
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	This subject provides information about various types of bacterial culture procedures, staining techniques, and biochemical tests used for the identification of bacteria. Students will learn about the morphological and cultural characteristics, biochemical properties, and laboratory diagnosis of different bacterial species.
Course Outcomes	By the end of this course, students will be able to **1.** Perform bacterial culture techniques. **2.** Apply appropriate staining methods. **3.** Conduct biochemical tests for bacterial identification. **4.** Recognise and interpret the morphological, cultural, and biochemical characteristics of various bacteria. **5.** Apply laboratory diagnostic methods for bacterial classification and analysis.

UNIT-I

Fundamentals of Bacterial Staining & Diagnostic

Overview: Significance and principles of staining in bacterial taxonomy and diagnostics; Procedures and interpretation of: Simple stain, Negative stain, Gram stain Albert's stain, Neisser's stain Ziehl–Neelsen stain, Capsule, Flagella, Spore stains Fontana stain for spirochetes; Diagnostic relevance tied to bacterial structures and classification; Overview of bacterial groups relevant to human health.

UNIT -II

Biochemical Identification of Bacteria: Diagnostic interpretation and significance of the following tests in systematic classification: Catalase, Coagulase, Indole, Methyl Red, Voges–Proskauer, Urease, Citrate, Oxidase, TSIA, Nitrate reduction, Carbohydrate fermentation, Bile solubility, H_2S production, Motility, Decarboxylases; Integration of biochemical patterns into genus/species-level diagnosis

UNIT - III

Gram-Positive & Gram-Negative Cocci: Study of morphological, cultural, biochemical characteristics, pathogenesis and laboratory diagnosis of – *Staphylococcus, Streptococcus, Pneumococcus, Haemophilus, Neisseria gonorhoeae* and *Neisseria meningitidis*

UNIT-IV

Enterobacteriaceae: Study of various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of bacteria- Enterobacteriaceae: *Escherichia, Citrobacter, Enterobacter, coli, Proteus, Klebsiella, Shigella, Yersinia enterocolitica* and *Yersinia pestis*

UNIT-V

Systemic & Atypical Bacterial Pathogens: Classification, morphology, pathogenicity, and diagnostics of: *Corynebacterium, Salmonella, Vibrio, Aeromonas, Plesiomonas, Clostridium species, Mycobacterium tuberculosis complex, M. leprae, Atypical Mycobacteria, Spirochetes: Treponema, Borrelia, Leptospira, Bordetella, Brucella, Mycoplasma, Ureaplasma, Rickettsia, Chlamydia, Actinomyces*, *Pseudomonas, Burkholderia.*

UNIT-VI

Non-sporing anaerobic cocci and bacilli: Classification & Morphology, pathogenicity, and diagnostics of - Anaerobic cocci: *Peptostreptococcus, Veillonella*;

Anaerobic Gram-positive bacilli: *Propionibacterium, Actinomyces spp.* (non-sporing)

Anaerobic Gram-negative bacilli: *Bacteroides, Fusobacterium, Prevotella*

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Text book of Microbiology	Ananthnarayanan & Paniker	Universities press
2	The Short Textbook of Medical Microbiology	Satish Gupte	Jaypee Brothers Medical Publishers
3	Medical laboratory Technology	Kanai L Mukherjee	McGraw Hill Co., New York.
4.	Text book of Microbiology	Prescott	McGraw Hill Co., New York.
5.	Diagnostic Microbiology,	Bailey & Scott	Elsevier
6.	Essentials of Microbiology	Surinder Kumar	Jaypee Brothers Medical Publishers
7.	Essentials in Medical Microbiology	Apurba Sankar Sastry & Sandhya Bhat K	Jaypee Brothers Medical Publishers

Medical Entomology and Parasitology

Course Code	MMLS532
Course Title	Medical Entomology and Parasitology
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objectives	This course enables students in medical laboratory science to equip students with an in-depth understanding of morphology, pathogenesis, diagnostics, and control strategies of medically important parasites and arthropod vectors. It supports clinical decision-making and laboratory proficiency in detecting and characterising parasitic infections and vector-borne diseases with health significance.
Course Outcome	By the end of this course, students will be able to **1.** Recognise global priority parasitic diseases and research advances **2.** Understand the classification and structure of parasites and arthropods of medical importance **3.** Explain life cycles, disease mechanisms, and host-pathogen interactions of protozoa and helminths **4.** Identify parasites and vectors using microscopy, serology, and molecular methods **5.** Analyse vector ecology and apply integrated control measures **6.** Interpret immunological and molecular diagnostics relevant to parasitology **7.** Recognise global priority parasitic diseases and research advances in their management.

UNIT-I

Introduction to Medical Parasitology & Entomology: scope and relevance; classification of medically important parasites and arthropods; transmission types, host categories, global burden and disease impact, emerging threats. Types of animal association, parasitism, commensalism, symbiosis, host adaptation mechanisms

UNIT-II

Protozoa: morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of nonpathogenic: *Entamoeba coli, Endolimax nana, Iodamoeba butschlii,* Free living Amoebae*: Naegleria, Acanthamoeba, Flagellates: Trichomonas, Giardia lamblia, Leishmania, Trypanosoma, Sporozoa: Malarial parasites, Bebesia, Toxoplasma gondii, Isospora belli, Cryptosporidium parvum, Cyclospora, Microsporida Ciliate: Balantidium coli.*

Explain zoonosis and drug resistance; opportunistic pathogens cause disease primarily in immunocompromised hosts.

UNIT-III

Helminths: Classify helminths; compare morphological features, transmission routes, and adaptation mechanisms.

Trematodes: morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of *Schistosoma species, Fasciola species, Fasciolopsis species, Clonorchis species, Paragonimus species.*

Cestodes: morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of *Taenia species, Echinococcus species, Hymenolepsis nana, Diphyllobothrium latum.*

Nematodes: morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of Intestinal Nematodes: A*scaris lumbricoides, Ancylostoma duodenale, Necator americanus, Strongyloids stercoralis, Trichinella spiralis, Enterobius vermicularis, Trichuris trichiura, Toxocara species*.
Lymphatic Nematodes: *Wuchereria bancrofti, Brugia malayi.*
Subcutaneous tissue Nematodes: *Loa loa, Onchocerca volvulus, Dracunculus medinensis.*

UNIT-IV

Introduction of Arthropods: classify the arthropods of public health importance; distinguish between vector and vehicle; vector control strategies (environmental control, chemical control, biological control, genetic control) approaches; role of vehicles and vectors in disease spread; Integrated approaches for parasite and vector control in endemic settings; vector surveillance, resistance anagement. Antiparasitic drugs.

UNIT-V

Arthropods of Medical Importance: morphology, life cycle, public health importance and control of Mosquitoes, Sandflies, Tse-tse fly, Blackflies, Fleas, Ticks and Mites, Cyclops, Housefly, Reduviid Bug, bed bug, lice.

UNIT-VI

Host–Parasite Immunology: Immune mechanisms against parasites; antigenic variation; vaccine prospects. hypersensitivity reactions; immunodiagnostic assay interpretation

UNIT-VII

Molecular Tools & Research Advances: PCR, LAMP, and sequencing methods; discuss application of proteomics, genotyping in parasite detection; introduce WHO neglected diseases and research foci. Introduces global parasitic disease priorities and current research in diagnostics and vaccines

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Textbook of Medical Parasitology	Ck Jayaram Paniker	Jaypee Brothers Medical Publishers (P) Ltd
2	Medical Parasitology	D.R. Arora & B. Arora	CBS publishers & distributors pvt. Ltd.
3	Textbook of Medical Parasitology	P. Chakraborty	New Central Book Agency
4	Protozoology and helminthology. Ltd	Chatterjee KD	CBS publishers & distributors pvt. Ltd
5.	Parasitology in Relation to Clinical Medicine	Chatterjee KD	CBS publishers & distributors
6.	Textbook of Medical Microbiology and Parasitology	Praful B. Godkar	Bhalani Publishing House
7.	Park's Textbook of Preventive and Social Medicine	K. Park	Banarsidas Bhanot Publishers

Immunology and Immunodiagnostics

Course Code	MMLS536
Course Title	Immunology and Immunodiagnostics
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objective	This course enables students in medical laboratory science to equip students with an in-depth understanding of advanced immunological concepts and diagnostic strategies relevant to infectious disease microbiology. It emphasises molecular mechanisms, immune dysfunctions, and clinical applications of immunodiagnostic technologies.
Course Outcome	By the end of the course, students will be able to **1.** Describe fundamental immune mechanisms involved in microbial defence, inflammation, and hypersensitivity. **2.** Interpret antigen presentation and MHC associations in infection susceptibility, autoimmunity, and transplant contexts. **3.** Evaluate immune dysfunctions including immunodeficiencies and autoimmune disorders with reference to microbial interactions. **4.** Apply principles of vaccine design and immune modulation to microbial pathogens and emerging clinical scenarios

UNIT I

Overview of Immunity: Evolution of immunity; innate and adaptive immunity; immunological memory; inflammation mechanisms; immune regulation and tolerance; relevance in infection detection and host defense mechanisms.

Immune Organs and Cells: Structure and functions of primary and secondary lymphoid organs; influence of microbiota on lymphoid development. Classification and roles of immune cells including T lymphocytes, B lymphocytes, natural killer cells, and dendritic cells.

Mechanisms of antigen processing and presentation, structural and functional diversity of immunoglobulin molecules, and the production and clinical applications of monoclonal antibodies.

UNIT II

Complement System & Effector Mechanisms: Overview of activation pathways—classical, alternative, and lectin—and their regulatory mechanisms. Functional roles in host defense, microbial clearance (e.g. *Neisseria*, *Candida*), inflammation, and autoimmune pathology. Diagnostic applications including CH50 and AH50 assays, and relevance in clinical Immunodiagnostics.

UNIT III

Immune Response: clonal selection theory and its significance in adaptive immune responses; differences between cell-mediated and humoral immunity.

Major Histocompatibility Complex & Antigen Presentation: structure, genetic polymorphism, and expression patterns of Major Histocompatibility Complex molecules; their role in presenting processed antigens to lymphocytes; disease associations involving MHC alleles; and their clinical relevance in infection susceptibility, autoimmune conditions and in organ transplantation.

UNIT IV

Lymphocyte Biology: Maturation, activation, differentiation of B lymphocytes and T lymphocytes; structural diversity of T-cell receptors; lymphocyte trafficking and homing mechanisms.

Cytokines & Immune Modulators: Classification and roles of cytokines; therapeutic applications; cytokine storm phenomena; kinin cascade and immune modulation

UNIT V

Hypersensitivity & Immune Dysregulation: the classification and pathophysiological mechanisms of hypersensitivity reactions (Type I to Type IV) and their clinical implications in transfusion reactions, allergic disorders, and autoimmune conditions; laboratory strategies to identify hypersensitivity responses

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UNIT VI

Immunodeficiency Syndromes: Primary immunodeficiencies; molecular mechanisms; diagnostic approaches; secondary infections post-immunosuppression; microbial vulnerability; relevant diagnostics pathways.

Autoimmunity & Tolerance: the mechanisms of central and peripheral immune tolerance; microbial mimicry in autoimmune diseases (*Campylobacter* in Guillain-Barré); immunological errors leading to autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis; diagnostic markers.

UNIT VII

Transplantation Immunology: Immune recognition in allografts and xenografts; pathways of rejection; pharmacological and immunological strategies for immunosuppression; significance of human leukocyte antigen matching; and influence of microbial factors on graft survival.

Tumor Immunology: the identification and roles of tumor associated antigens; immune evasion by pathogens; mechanisms of immuno-surveillance.

UNIT VIII

Immunogenetics & Epigenetics: genetic determinants of immune variability and disease susceptibility; HLA associations with microbial and autoimmune diseases; epigenetic regulation of immune responses; clinical application of immunogenetics and epigenetics in diagnostics and predictive medicine.

UNIT IX

Systems Immunology & Immune Profiling: Highthroughput immunological assays; transcriptomic & proteomic responses to pathogens; microbiome-immune interactions; bioinformatics for infection tracking.

UNIT X

Vaccine Design and Immunodiagnostics: Foundational principles of vaccine design and administration, including microbial antigen selection, immune activation, and immunological memory formation.

Immunodiagnostic techniques ELISA, flow cytometry, and lateral flow assays for detecting microbial infections. Advanced immunotherapies -Chimeric Antigen Receptor Tcell therapy and immune checkpoint blockade therapy and their diagnostic relevance in infection-linked immune modulation.

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Kuby Immunology, 5th Edition	Punt, J., Stranford, S., Jones, P., Owen, J.A	W.H.Freeman & Co Ltd
2.	Essential Immunology, 9th Edn.	Ivan M. Roitt	Blackwell Science, Inc.
3.	Medical Immunology	Parslow, T.G., Stites, D.P., Terr, A.I.	McGraw Hill
4.	Roitt's Essential Immunology,	Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M.	Wiley-Blackwell
5.	Textbook of Microbiology and Immunology	Subhash Chandra Parija	Elsevier
6.	Essentials of Immunology	S.K. Gupta	Jaypee Brothers Medical Publisher
7.	Textbook of Basic andbook of Basic and Clinical Immunology	Gangal, S., Sontakke, S.	Universities Press (India) Pvt. Ltd.
8.	Handbook of Human Immunology	Mary S. Leffell,& Noel R. Rose,	CRC press
9.	Fundamentals of Immunology	Paul, W.	L. Williams & Wilkins
10.	Janeway's Immunobiology, 6th edition	Charles Janeway	Garland Science

Systematic Bacteriology Practical

Course Code	MMLS530
Course Title	Systematic Bacteriology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objective	This subject provides information about various types of bacterial culture procedures, staining techniques, and biochemical tests used for the identification of bacteria. Students will learn about the morphological and cultural characteristics, biochemical properties, and laboratory diagnosis of different bacterial species.
Course Outcome	By the end of this course, students will be able to **1.** Apply appropriate aseptic methods for specimen collection & transportation **2.** Perform quantitative bacteriological analysis of food, water, and milk samples and interpret microbiological quality based on national and international standards such as ICMR and WHO guidelines. **3.** Isolate, identify, and characterize clinically significant microorganisms from various clinical specimens using selective and differential culture media, colony morphology, staining techniques, biochemical tests, and automated identification systems. **4.** Apply integrated diagnostic approaches for the laboratory diagnosis of infectious diseases such as urinary tract infections (UTIs), sexually transmitted infections (STIs), and tuberculosis (TB), correlating laboratory findings with clinical presentations. **5.** Explain the principles, workflow, applications, and limitations of automated microbiological diagnostic platforms including VITEK, MALDI-TOF MS, and Phoenix systems, and compare their performance with conventional manual methods. **6.** Interpret complex microbiological case scenarios involving antimicrobial resistance and infectious diseases, including ESBL-producing *Escherichia coli*, *Chlamydia trachomatis*, *Treponema pallidum*, and *Mycobacterium tuberculosis*, to support evidence-based clinical decision-making.

LIST OF PRACTICALS

1. **Advanced Specimen Collection & Transport:** Selection of specimen type based on clinical suspicion, Aseptic techniques for collection, Transport media and conditions for fastidious organisms

2. **Bacteriological analysis** of food, water, and milk using quantitative methods,interpretation based on permissible limits (ICMR/WHO guidelines)

3. **Isolation & Identification from Clinical Samples:** Targeted media selection (e.g., XLD, TCBS, CLED), Colony morphology, pigment production, and hemolysis, Biochemical test panels and automated ID confirmation

4. **Integrated Diagnostic Strategies:** Stepwise approach to diagnosing UTI, STI, TB, etc., Case-based

interpretation and clinical correlation

5. **Automation Platforms (Demo/Simulation):** Principle and workflow of VITEK, MALDI-TOF, and Phoenix, Comparative analysis: manual vs. automated results

6. **Case-Based Lab Interpretation:** UTI with ESBL-producing *E. coli*, Genital ulcer workup with *Chlamydia* and *Treponema*, TB diagnostics integrating smear, culture, and GeneXpert

NOTE:- Clinical Laboratory rotation/observation can be incorporated wherever possible

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Practical Medical Microbiology,	Mackie & McCartney	Elsevier
2	Text book of Microbiology	Ananthnarayanan & Paniker	Universities press
3	The Short Textbook of Medical Microbiology	Satish Gupte	Jaypee Brothers Medical Publishers
4.	Medical laboratory Technology	Kanai L Mukherjee	McGraw Hill Co., New York.
5.	Text book of Microbiology	Prescott	McGraw Hill Co., New York.
6.	Diagnostic Microbiology,	Bailey & Scott	Elsevier
7.	Essentials of Microbiology	Surinder Kumar	Jaypee Brothers Medical Publishers
8.	Essentials in Medical Microbiology	Apurba Sankar Sastry & Sandhya Bhat K	Jaypee Brothers Medical Publishers

Medical Entomology and Parasitology Practical

Course Code	MMLS534
Course Title	Medical Entomology and Parasitology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course objective	This course enables students in medical laboratory science to equip students with an in-depth understanding of morphology, pathogenesis, diagnostics, and control strategies of medically important parasites and arthropod vectors. It supports clinical decision-making and laboratory proficiency in detecting and characterising parasitic infections and vector-borne diseases with health significance.
Course Outcome	At the end of the course, students should be able to 1. Apply biosafety practices for safe collection, handling, transport, and disposal of clinical specimens. 2. Identify parasites by wet mounts, oncentration and staining techniques. 3. Identify medically important helminth ova and larvae based on morphological characteristics. 4. Prepare and interpret blood smears for the diagnosis of malaria and filarial infections. 5. Integrate laboratory findings with clinical case scenarios for parasitic disease diagnosis. 6. Perform and interpret serological tests such as ELISA and rapid diagnostic assays for parasitic infections.

LIST OF PRACTICALS

1. Specimen Handling and Biosafety-safe specimen collection, transport, labelling, and disposal procedures, Use of PPE and biosafety guidelines, and sample handling.

2. Wet Mount Preparation & Microscopy -Saline and iodine mounts; faecal smear preparation and observation; parasite sketching and labelling.

3. Concentration & Staining Methods- Floatation and sedimentation techniques; basic stains (Giemsa, methylene blue); image-based interpretation.

4. Identification of Helminth Ova and Larvae- Morphology of ova and larval stages under microscope; faecal concentration spotters.

5. Blood Parasite Detection-Thick and thin blood smear preparation; Giemsa staining; malaria and filarial parasite detection.

6. Arthropod Identification - using charts, preserved samples, shared slides.

7. Case Scenario Integration - disease link discussion; mapping activity with clinical cues.

8. Serological Diagnostic Techniques - ELISA and rapid card tests for parasitic infections; result interpretation and trouble-shooting

Note:- Clinical laboratory rotation/observation can be incorporated wherever possible

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Textbook of Medical Parasitology	Ck Jayaram Paniker	Jaypee Brothers Medical Publishers (P) Ltd
2	Medical Parasitology	D.R. Arora & B. Arora	CBS publishers & distributors pvt. Ltd.
3	Textbook of Medical Parasitology	P. Chakraborty	New Central Book Agency
4	Protozoology and helminthology. Ltd	Chatterjee KD	CBS publishers & distributors pvt. Ltd
5.	Parasitology in Relation to Clinical Medicine	Chatterjee KD	CBS publishers & distributors
6.	Textbook of Medical Microbiology and Parasitology	Praful B. Godkar	Bhalani Publishing House
7.	Park's Textbook of Preventive and Social Medicine	K. Park	Banarsidas Bhanot Publishers

Immunology and Immunodiagnostics Practical

Course Code	MMLS538
Course Title	Immunology and Immunodiagnostics Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective	This course enables students in medical laboratory science to equip students with an in-depth understanding of advanced immunological concepts and diagnostic strategies relevant to infectious disease microbiology. It emphasises molecular mechanisms, immune dysfunctions, and clinical applications of immunodiagnostic technologies.
Course Outcome	At the end of the course, students should be able to: **1.** Demonstrate laboratory safety practices, biomedical waste management, and adherence to quality standards in a clinical hematology laboratory. **2.** Apply pre-analytical procedures, including patient identification, preparation, specimen collection, transportation, processing, and acceptance/rejection criteria to ensure sample integrity. **3.** Perform venous blood collection using standard phlebotomy techniques and demonstrate the correct order of draw for blood specimens. **4.** Conduct routine hematological investigations, including hemoglobin estimation, packed cell volume (PCV), erythrocyte sedimentation rate (ESR), and reticulocyte count, following standard laboratory protocols. **5.** Prepare, stain, and examine peripheral blood smears using Romanowsky stains and perform differential leukocyte count (DLC) for hematological evaluation. **6.** Perform manual hematological cell counts, including RBC count, WBC count, platelet count, and absolute eosinophil count, and calculate red cell indices for clinical interpretation. **7.** Assess hemostatic function by performing bleeding time and clotting time tests and correlate findings with normal physiological processes. **8.** Operate automated hematology analyzers, interpret hematological parameters, and compare automated results with manual laboratory findings for quality assessment.

LIST OF PRACTICALS

1. **Sample Collection & Handling** - Blood, serum, and tissue sampling for immunological assays; biosafety and ethical protocols.

2. **Peripheral Blood Smear Interpretation** -Identification of major immune cells and lymphoid structures related to infection defense.

3. **Immunoassays** -Agglutination, flocculation, ELISA, WIDAL, CRP, Coombs, ASLO, and RPR tests

4. **Immunoblotting & Lateral Flow Techniques** -Interpretation of infectious disease strips (e.g. malaria, HIV rapid cards)

5. **Antibody Titer Estimation** -Dilution-based methods for semi-quantitative antibody analysis

6. **Flow Cytometry** -Immunophenotyping of immune cells and gating analysis

7. **Immunofluorescence (Direct & Indirect)-**Microscopic detection of immune markers for diagnostic applications

8. **Autoimmune Marker Detection** -Rheumatoid Factor, Anti-CCP, and Antinuclear Antibody (ANA) assays

9. **Biosafety & Quality Control in Immunodiagnostics** -Practices for accuracy, reproducibility, and documentation in clinical labs

10. **Clinical Case Analysis** -Case-based interpretation of immune dysfunction in infectious disease contexts

Note:- Clinical Laboratory rotation/observation can be incorporated wherever possible

THIRD SEMESTER

Clinical Biochemistry I

Course Code	MMLS601
Course Title	Clinical Biochemistry I
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	The Course will equip the student with the knowledge of disorders related to the respective metabolisms taking place in the body. The course emphasizes on the understanding of metabolic pathways and biochemical changes associated with various pathological conditions.
Course Outcome	At the end of the course, students should be able to: **1.** Understand the principles of biochemical processes and how they relate to normal and diseased states. **2.** Identify and explain the significance of common biochemical markers used in diagnostics and monitoring of disease. **3.** Perform key biochemical laboratory techniques and follow proper sample handling procedures

UNIT-I

Role of biochemistry in diagnosis of diseases:

Use of Biochemical data in clinical medicine: Specific uses of biochemical tests in screening, diagnosis, prognosis and management, Acquisition & Interpretation of biochemical data.

Specimen receiving and processing: Types of body fluid specimens received in the lab (Whole blood, Urine, CSF and other fluids)

Appropriate specimen collection

- Factors affecting test results - Preanalytical variables
- Preservatives for combined biochemical analysis in urine.
- Basic concepts: random error, systematic error, analytical range, sensitivity, specificity, detection limit, interferences, recovery, Accuracy, Precision
- Biological reference intervals
- Benchmarking, continuous Quality improvement
- Quality indicators (QI): Rejection criteria, Hemolysed rejection rate, TAT (turn around time), critical value reporting, IQC cv% performance, EQA performance; Importance of QI
- Selection and evaluation /validation of new methods, Analytical performance criteria: Method comparisons, accuracy, within run-precision
- Instrument comparison in laboratory for an assay.

UNIT-II

Disorders of carbohydrates metabolism:

- Glucose level in normal blood, renal threshold
- Diabetes Mellitus: classification and Pathogenesis of DM
- Diabetic ketoacidosis and diabetic coma, secondary degenerative changes associated with diabetes mellitus.

- Hyper glycemia, Hypoglycaemia, glycosuria and Renal Glycosuria
- **Laboratory diagnosis**: specimen collection, Patient Instructions, storage; principle, estimation, reference range, clinical significance of Plasma glucose (fasting, post prandial, random), Oral Glucose Tolerance Tests, Glucose challenge test, urine microalbumin, Glycated haemoglobin, qualitative tests for sugars in urine, Ketone bodies, Plasma lactate.
- Diagnosis of inborn errors of carbohydrate metabolism by qualitative and chromatographic techniques.
- Self-monitoring of blood glucose and Contionous glucose monitoring (CGM)

UNIT-III

Disorders of lipid metabolism:

- Plasma triglycerides, Cholesterol, HDL cholesterol, LDL cholesterol levels
- Familial hypercholesterolemia, hypo and hyper cholesterolemia, Fatty liver, Hyper and hypo lipoproteinemia, hypertriglyceridemia, Dyslipidemia, Atherosclerosis and Myocardial Infarction, ketosis, fatty liver, coronary heart disease.
- **Laboratory diagnosis** : Specimen collection, Patient Instructions Principle, estimation, reference range and clinical significance - lipid profile (serum cholesterol, triglycerides, HDL, LDL, HDL:LDL)
- Diagnosis of inborn errors of lipid metabolism
- Diagnosis of various disorders by lipoprotein by electrophoresis

UNIT-IV

Disorders of Amino acid and protein metabolism:

- **O**verview of plasma proteins and their disorders, multiple myeloma, Paraproteinemia
- **Laboratory diagnosis** : Specimen collection, Principle, estimation, reference range and clinical significance of : proteins in blood (albumin, α1-antitrypsin, α1-fetoprotein, C-reactive protein, β2-microglobulin), serum Immunoglobulins;
- Protein in other body fluids (Urine, CSF, Pleural fluid, Ascitic Fluid) laboratory evaluation of paraproteinemia: Electrophoresis of plasma and urine proteins,
- quantification for diagnosis of multiple myeloma (M band
- Quantification)
- **Disorders of nitrogen metabolism:** Excretion of nitrogenous waste products, abnormalities of nitrogen metabolism including uremia, Uric aciduria, aminoaciduria
- **Laboratory diagnosis**: Principle, estimation, reference range and clinical significance of Ammonia, urea, uric acid, creatinine.
- Diagnosis of inborn errors of Amino acid and protein metabolism by qualitative and quantitative methods

UNIT-V

Minerals and Trace Metal disorders :

- Overview of Mineral and trace metal disorders- Anaemia, Hypercalcemia, Phosphatemia, Wilson disease, etc
- **Laboratory diagnosis:** Principle, estimation, reference range and clinical significance: disorders related to iron, calcium, phosphorus, magnesium, copper and zinc

UNIT-VI

Lab diagnosis of porphyrias.

- Clinical significance and disease correlation
- Urine qualitative tests (porphyrins, coproporphyrin, uroproporphyrin , d-ALA, porphobilinogen, urobilinogen

UNIT-VII

Clinical Enzymology:

- Sources of plasma enzymes, diagnostic importance and their interpretation
- **Laboratory evaluation of enzymes**- Principle, estimation, reference range, and clinical significance: Amylase, Lipase, aminotransferase, gamma glutamyl transferase, alkaline phosphatase, creatinine kinase, cholinesterase, lactate dehydrogenase, lipoprotein lipase, LDH, Acid phosphatase

UNIT-VIII

Fluid and electrolyte balance disorders:

- Disorders of fluid and electrolyte balance
- **Laboratory diagnosis** Principle, estimation, reference range, and clinical significance Electrolytes (sodium, potassium, chloride, bicarbonate)
- **Acid base balance**
- Disorders of Acid base balance- Metabolic acidosis, Metabolic alkalosis, Respiartory Acidosis and Respiratory Alkalosis mixed disturbances.
- Blood gases. Reference intervals for arterial blood gases. Acquisition of arterial blood gas samples.
- **Laboratory diagnosis: laboratory** parameters for blood gas analysis: Arterial Blood gas estimation. pCO2, O2 and pH.

Text and Reference Books

S.No.	Name/Title	Author	Publisher
1.	Lehninger Principles of Biochemistry,7th Edition	David L. Nelson & Michael M. Cox	W.H. Freeman
2.	Textbook of Medical Biochemistry	M.N. Chatterjee & Rana Shinde	Jaypee
3.	Harper's Illustrated Biochemistry	Robert K. Murray et al.	Tata McGraw-Hill
4.	Varley's Practical Clinical Biochemistry	Alan Gowenlock	CBS
5.	Biochemistry	Debajyoti Das	Academic publishers

Clinical Biochemistry II

Course Code	MMLS605
Course Title	Clinical Biochemistry II
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	The Course will provide the students with the knowledge of disorders related to the respective organs in the body. The course emphasizes on the understanding of biochemical changes associated with various pathological conditions
Course Outcome	At the end of the course, students should be able to **1.** Describe the biochemical basis of major diseases such as diabetes, renal failure, liver disorders, and cardiovascular diseases. **2.** Interpret clinical laboratory results, linking biochemical findings with patient conditions. **3.** Identify and explain the significance of common biochemical markers used in diagnostics and monitoring of disease.

UNIT-I

Liver Function tests: Overview of Anatomy of liver and its functions

- **Liver diseases:** Liver cirrhosis, Hepatitis, liver failure, hepatic coma and Biliary tract diseases- gall stones and cholecystitis
- **Indications and Classification of liver function test:** Tests based on abnormalities of bile pigment metabolism, Jaundice and differential diagnosis of Jaundice, Test based on changes in plasma proteins, serum enzyme activities, abnormalities of lipids, abnormalities of Carbohydrate metabolism, detoxification function of liver, excretory capacity of liver
- Laboratory analysis of gall stones

UNIT-II

Renal function tests: Overview of anatomy of kidney and its functions

- **Renal diseases:** Nephrotic syndrome, Glomerular nephritis, Urolithiasis and nephrolithiasis, renal calculi, renal tabular acidosis, diabetes insipidus, renal hypertension, renal failure
- Indication and classification of RFT, Test based on glomerular filtration test -Urea, creatinine, Inulin, Cystatin Clearance test, Test based on Renal Plasma flow clearance and tubular filtration
- Miscellaneous test
- **Routine RFT:** serum creatinine, urea, uric acid and proteinuria
- Early marker of Renal Pathology. - Microalbuminuria, Urine albumin: creatinine ratio
- Renal handling of electrolytes- Sodium, potassium, Fractional excretion of Sodium (FeNa)
- Renal calculi
- Measurement of serum and urine osmolality
- Urine analysis for normal and abnormal constituents of urine

UNIT-III

Gastric and pancreatic function tests

- Composition of Gastric juice
- Outline of clinical manifestations of gastric, pancreatic and intestinal diseases.
- Indications, classification of gastric function test and Pancreas Function test
- Qualitative and quantitative analysis of gastric contents and duodenal contents
- Pancreatic enzymes: Amylases, lipases

UNIT-IV

Cardiac function tests

- Biochemistry and tissue distribution of cardiac markers.
- Cardiac enzymes such as CKMB, CK, homocysteine, hsCRP
- Cardiac troponins and myoglobin

UNIT-V

Endocrine function Test: Overview of disorders of-

- Hypothalamus, pituitary, thyroid, adrenal cortex, pancreas, placental, testes, ovaries
- Analysis of hormones - T3, T4, TSH, FT3, FT4, antiTPO, Prolactin, Testosterone, Chorionic gonadotropin (BHCG), FSH, LH, Estradiol, progesterone, Insulin, ACTH, Cortisol.
- Dexamethasone suppression test

UNIT-VI

Tumor markers

- Tumor marker and its classification
- Potential uses of tumor markers
- Marker detection - PSA, β-hCG, AFP, CEA, CA15-3, CA- 125, CA 19-9.

UNIT-VII

Toxicology testing in Clinical laboratory:

1. Therapeutic drugs and their management (TDM):

- Therapeutic drugs – Definition, Mechanism of action, Absorption, Distribution, Biotransformation, Excretion and Clinical utility.
- Overview of specific drugs and analysis of Carbamazepine, Phenobarbital, Phenytoin, Valproic acid, Digoxin, Theophylline, Cyclosporine, Lithium

2. Toxic agents: Source, Routes of entry and the effect of Carbo

UNIT-VIII

Paediatric clinical biochemistry

- Problems of specimen collection
- Biological reference intervals
- Heavy metal poisoning in children: Pb, Hg .
- Overview of Newborn screening - Cystic fibrosis, neonatal TSH, G6PD, PKU and Galactosemia

UNIT- IX

Point-Of-Care-Testing (POCT):

- Objectives, Biochemical parameter measured by POCT devices, Common POCT devices and Technologies, Requirements, Advantages, Limitation and Challenges

UNIT-X

Automation and AI in Clinical Biochemistry:

- History of automated analyzers, Types of automation, Total laboratory automation
- Objectives of AI integration, Application of AIDiagnostic support, Data Analysis, Lab workflow optimization, Clinical Decision Support System, Predictive and preventive Healthcare
- Challenges and Limitations

Text and Reference Books:

S.No.	Name/Title	Author	Publisher
1.	Lehninger Principles of Biochemistry,7th Edition	David L. Nelson & Michael M. Cox	W.H. Freeman
2.	Textbook of Medical Biochemistry	M.N. Chatterjee & Rana Shinde	Jaypee
3.	Harper's Illustrated Biochemistry	Robert K. Murray et al.	Tata McGraw-Hill
4.	Varley's Practical Clinical Biochemistry	Alan Gowenlock	CBS
5.	Biochemistry	Debajyoti Das	Academic publishers

Immunology

Course Code	MMLS609
Course Title	Immunology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective(CO)	A sound knowledge of immunology is required by a Medical Laboratory Science scholar to understand the immune responses which underlie many clinically important states. The in depth theoretical and practical concepts imbibed by the graduate during the course helps in laboratory diagnosis of immune related clinical conditions like hypersensitivity, allergy, immuno pathology etc.
CourseOutcome	At the conclusion ofthecourse, students will; **1.** Understand and diagnosis based on immune reactions **2.** Achieve expertise in immunology techniques. **3.** Detect and correct errors in techniques

UNIT-I

Overview of the Immune System- Cells, tissues and organs of the immune system

UNIT-II

Types of Immunity:

1. Innate immunity

a. Anatomical barriers-skin, mucous lining, cilia, saliva, tears etc.
b. Role of T cells
c. Cellular immunity-neutrophils, macrophages, dendritic cells, natural killer cells
d. Inflammation-vasodilation, extravasation, oedema, chemokines, integrin, ICAMs, cytokines (defensins, cathelicidins, interferons,etc.)
e. Acute Phase Response proteins (APR proteins)-Creactive protein, mannose-binding lectin etc.)
f. Receptor system-complement receptor, MBL receptor, Toll-like receptor, scavenger receptor etc
g. Signal transduction pathway eg. TLR signaling

2. Adaptive Immune system

a. a) Antigen- types, Antigen properties contributing immunogenicity- molecular size, chemical composition, genotype, dosage, route of entry etc.
b. Role of B cells
c. Immunoglobulins- types, structure, antibodymediated effector functions-opsonization, complement activation, ADCC (antibody dependent cell mediated cytotoxicity), transcytosis,
d. Avidity, affinity and cross reactivity
e. Antigen-antibody interactions: precipitation, agglutination, opsonisation, complement fixation
f. Immunoglobulin superfamily

UNIT-III

Major Histocompatibility Complex (MHC) molecule class I and class II: Their differences and interactions

UNIT-IV

Hypersensitivity Type I, Type II, Type III and type IV: Allergy, skin tests, transfusion reactions, hemolytic disease of the newborn, Immune Complex diseases, tuberculin test

UNIT-V

Autoimmunity and disorders: SLE, Multiple sclerosis, Rheumatoid arthritis, Mysthenia gravis, Autoimmune Thyroiditis

UNIT-VI

Immunodeficiency diseases

a) Primary immunodeficiency: involving lymphoid immune deficiency (B cells, T cells), involving myeloid lineage, Immune complex diseases
b) Secondary immunodeficiency: AIDS

UNIT-VII

Tumor immunology: Tumor antigens, tumor immune surveillance, tumor escape and Tumor Markers

UNIT-VIII

Transplantation and rejection: Role of T cells, Immune recognition in Allograft and Xenograft, pathway of rejection

UNIT-IX

Vaccination: Principle, types, vaccine development, adjuvants

UNIT-X

Immunological techniques

a) Precipitation reactions: Immuno diffusion, immune electrophoresis, Immunoprecipitation
b) Agglutination reactions: Blood group typing, Bacterial agglutination, Agglutination inhibition
c) Complement fixation
d) Neutralisation
e) Opsination
f) Immnunofluorescense
g) ELISA
h) FIA and RIA
i) Western Blotting
j) Flow cytometry
k) Immunoelectron microscopy

Text and Reference Books

S. No	Name	Author(S)	Publisher
1.	Kuby Immunology, 5th Edition	Punt, J., Stranford, S., Jones, P., Owen, J.A	W.H.Freeman & Co Ltd
2.	Roitt's Essential Immunology	Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M.	Wiley-Blackwell
3.	Medical Immunology	Parslow, T.G., Stites, D.P., Terr, A.I.	McGraw Hill
4.	Textbook of Basic andbook of Basic and Clinical Immunology	Gangal, S., Sontakke, S.	Universities Press (India) Pvt. Ltd.

Endocrinology & Biochemistry of aging

Course Code	MMLS613
Course Title	Endocrinology & Biochemistry of aging
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	This course provides knowledge of endocrine system which plays regulatory role controlling and influencing the functioning of all other systems of the human body. Students will also gain knowledge chronic disease burden, a biochemical understanding of aging processes such as oxidative stress, cellular senescence, and hormonal imbalance .
Course Outcome	At the end of the course, students should be able to **1.** Describe the structure, synthesis, and regulation of hormones produced by major endocrine glands. **2.** Apply the knowledge and the associated techniques for diagnosing hormonal disorders. **3.** Understand molecular theories of aging, including oxidative stress, telomere shortening, mitochondrial dysfunction, and genetic regulation

UNIT-I

Introduction to Endocrinology; Neuro-endocrinology, Neuro-immuno endocrinology and their general principles. Types of endocrine glands and classification of hormones based on their chemical nature and function.

UNIT-II

Chemistry, synthesis, mechanism of action, physiological effects,catabolism of the hormones of Hypothalamus and Pituitary gland and their disorders.

UNIT-III

Chemistry, synthesis, mechanism of action, physiological effects, catabolism of Thyroid, Parathyroid (calcium homeostasis hormones). GIT hormones, Pancreatic Hormones and their disorders.

UNIT-IV

Chemistry, synthesis, mechanism of action, physiological effects, Catabolism of the hormones of Adrenal glands, Gonads and their disorders.

Extra endocrine hormones- ANP, Erythropoietin, Melatonin, etc

UNIT-V

Introduction to aging: Definition and biological aspects of aging.

Theories of Aging - Free radical theory, Mitochondrial theory, Telomere shortening and cellular senescence, Genetic and epigenetic regulation of aging, Immunosenescence and inflammation, and Hormonal theories of aging (endocrine dysregulation)

UNIT-VI

Mechanism of Aging:

Cellular mechanism: Cellular senescence, Oxidative stressimbalance between production of ROS, Telomere shortening,Mitochondrial dysfunction

Genetic mechanism: Genetic blue print in determining susceptibility to Alzhiemer's, cardio vascular diseases, certain cancers, Genetic variability in life span, Telomere length, Metabolic genetic-insulin sentivity, metabolic rate, nutrient utilization, metabolic disorders like diabetes, obesity

UNIT-VII

Age associated common disorders-atherosclerosis, neoplasms, cataracts, macular degeneration, neuro degenerative disorders, neuro endocrine disorders, Cancer and aging: biochemical connections

Text and Reference Books

S. No.	Name/Title	Author	Publisher
1	Principles of Genome Analysis and Genomics	Sandy B. Primrose, Richard Twyman	Wiley-Blackwell
2.	Transcriptomics and Proteomics,	P.B. Gupta	Elsevier
3.	Microbial Proteomics: Functional Biology of Whole Organisms	Michael Hecker, Ian Humphery-Smith	John Wiley & Sons
4.	Microbial system biology	Alexander	Springer
5.	Molecular Genetics	Stanley R. Maloy, John E. Cronan, Jr., David Freifelder	Jones and Barlett Publishers
6.	Molecular Genetics of Bacteria	Larry Snyder and Wendy Champness	ASM Press, Washington, D.C.
7.	Essentials of Molecular Biology	George M. Malacinski, David Freifelde	Jones and Barlett Publishers
8.	Genomes, Third Edition	T. A. Brown	Wiley-Liss
9.	Bioinformatics: Principles and Applications	Zhumur Ghosh , Bibekanand Mallick	Oxford

Clinical Biochemistry I Practical

Course Code	MMLS603
Course Title	Clinical Biochemistry I Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	This course provides a comprehensive understanding of the biochemical basis of health and disease, and the role of biochemical tests in diagnosis. Students will gain practical skills essential for working in diagnostic laboratories in clinical and research lab.
Course Outcome	At the conclusion of The course, Students will : **1.** Perform and interpret biochemical investigations related to carbohydrate metabolism and Analyze disorders of carbohydrate metabolism through qualitative tests. **2.** Evaluate lipid metabolism by performing lipid profile analysis and lipoprotein electrophoresis. **3.** Assess protein metabolism and inflammatory conditions through serum protein, albumin and Investigate amino acid and trace element disorders using qualitative tests **4.** Perform renal function tests, electrolyte analysis, arterial blood gas analysis, and interpret acid-base, electrolyte imbalances and associated biochemical findings. **5.** Estimate clinically important enzymes and interpret their diagnostic significance in disease conditions. **6.** Apply quality control and quality assurance practices using Westgard rules and Levey–Jennings (LJ) chart analysis for clinical biochemistry laboratories.

LIST OF PRACTICALS

1. Estimation of plasma glucose
2. Oral Glucose tolerance test
3. Glucose challenge test
4. Estimation of Glycosylated hemoglobin
5. Estimation urine Microalbuminuria
6. Qualitative Analysis of urine for sugars and ketone bodies
7. Estimation of plasma lactate
8. Qualitative Analysis for Fructosuria, galactosemia, pentosuria
9. Chromatography for separation of sugars
10. Lipid profile- TG, Cholesterol and HDL cholesterol
11. Lipoprotein Electrophoresis
12. Estimation of serum protein and Albumin
13. Serum protein Electrophoresis and quantification of band
14. Estimation of C reactive protein
15. Qualitative Analysis of Urinary protein

16. Estimation of Urea, Uric acid, Blood urea nitrogen, creatinine
17. Qualitative methods for Individual aminoacids
18. Chromatography Techniques (HPLC)- Aminoaciduria and disorder of Amino acid
19. Estimation of Iron, Calcium, phosphorus, Magnesium, Copper and Zinc
    - Urine qualitative tests for porphyria
    - Estimation of clinically important enzymes – SGOT, SGPT, Alkaline phosphatase, GGT, LDH, Lipase, Amylase, CK
    - Electrolyte Estimation
    - Arterial blood collection and Analysis of Blood gas
    - Westgard rule, LJ Graph data analysis

Clinical laboratory rotation/observation can be incorporated wherever possible

Clinical Biochemistry II Practical

Course Code	MMLS607
Course Title	Clinical Biochemistry II Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	This course provides a comprehensive understanding of the biochemical basis of health and disease, and the role of biochemical tests in diagnosis. Students will gain practical skills essential for working in diagnostic laboratories in clinical and research lab.
Course Outcome	At the conclusion of the course, Students will : 1. Explain the principals of disease,causation with particular emphasis on modifiable environmental factors 2. Encourage the application of epidemiology to the prevention of disease and promotion of health including environmental and occupational health. 3. To ensure that health recourses are used to the best possible effect.

LIST OF PRACTICALS

1. Project: Descriptive Epidemiology of a selected Health Problem
2. Survey Design: Create a Community Health Survey Tool
3. Demonstration: Use of GIS Tools/Software for Disease Mapping (Virtual/Manual)
4. Case Study Analysis of Disease Outbreak
5. Detect presence of potential nosocomial pathogens from swabs collected from inanimate objects in a hospital environment.
6. Segregation and Colour-Coding of Biomedical Waste
7. Demonstration of Waste Treatment Methods
8. Case Study: Anthrax or Other Bioterrorism Events
9. Demonstration/Visit: Public Health Lab or Hospital Epidemiology Unit

Clinical laboratory rotation/observation can be incorporated wherever possible

Immunology Practical

Course Code	MMLS611
Course Title	Immunology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective(CO)	This course equips students with hands-on skills essential for understanding immune responses, diagnostic techniques, and experimental methods used in immunological research and clinical laboratories
CourseOutcome	At the conclusion ofthecourse, students will; **4.** Understand and diagnosis based on immune reactions **5.** Achieve expertise in immunology techniques. **6.** Detect and correct errors in techniques

LIST OF PRACTICALS

1. Specimen collection and preparation of reagents and buffers
2. ABO and Rh typing using agglutination
3. Qualitative tests - precipitation, agglutination
4. Double Diffusion
5. Radial Immunodiffusion Assay
6. ELISA
7. Detection of rheumatoid factor
8. Estimation of C-reactive protein (CRP)
9. Separation of Immunoglobulins by Chromatography
10. Demonstration of western blot
11. Demonstration of Immunofluorescence.
12. Demonstration of Flow cytometry

Medical Virology

Course Code	MMLS625
Course Title	Medical Virology
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	This course is designed to provide postgraduate students in medical laboratory technology with an in-depth understanding of virology, including viral pathogenesis, replication strategies, host-virus interactions, and modern approaches to laboratory diagnosis of viral infections. Emphasis will be placed on molecular virology, emerging and re-emerging viral infections, biosafety practices, and the application of cutting-edge diagnostic tools for clinical and public health use.
Course Outcome	At the end of the course, students should be able to: **1.** Describe viral structure, classification, genome organisation, and replication mechanisms of major virus families. **2.** Explain host-virus interactions, mechanisms of viral pathogenesis, and immune evasion strategies. **3.** Evaluate molecular and serological techniques used in the detection, quantification, and genotyping of viruses. **4.** Interpret laboratory results in the context of clinical virology, outbreak investigation, and surveillance. **5.** Apply biosafety and biosecurity principles in the handling of clinical viral specimens and high-risk pathogens. **6.** Discuss current trends in antiviral therapy, vaccine development, and viral epidemiology.

UNIT-I

General Properties of Viruses: Morphology, Viral Hemagglutination, Viral Multiplication, Cultivation of Viruses- Animal inoculations, Egg inoculation, Cell culture, Viral Assay, Assay of Infectivity, Viral Genetics, NonGenetic Interactions, Classification and Nomenclature of Viruses, Viroids, Prion; Viral genomics and bioinformatics tools.

UNIT-II

Virus- Host Interactions: Viral Infections: Pathogenesis of Viral Infection, Host Response to Virus Infections; Laboratory Diagnosis of Viral Diseases, Immunoprophylaxis of Viral Diseases, Chemoprophylaxis and Chemotherapy of Virus Diseases

UNIT-III

Bacteriophages: Morphology, life cycle, transmission of genetic information**, s**ignificance of phages

UNIT-IV

Orthomyxoviruses: Morphology, Resistance, Antigen classification; Influenza virus- classification, Nomenclature systems, Antigenic variation, Host range, Pathogenicity, Clinical features, Laboratory diagnosis, Immunity, Epidemiology, Immunoprophylaxis, Treatment.

UNIT-V

Paramyxoviruses: Antigenic Structure and classification of:

- Rubella viruses, Mumps virus: Properties, clinical features, complications, Epidemiology, Immunity, Laboratory Diagnosis, Prophylaxis
- Parainfluenza viruses: • Clinical features, Epidemiology, Laboratory diagnosis,
- New Castle Disease viruses (NDV)
- Pneumovirus-
- Respiratory Syncytial virus (RSV): Clinical features, Epidemiology, Laboratory features, Epidemiology, Laboratory diagnosis, Prophylaxis, Treatment
- Morbillivirus
- Measles virus: Epidemiology, clinical features, complications, Pathogenicity, Laboratory Diagnosis, Prophylaxis
- Nipah and Hendra virus
- Human Metapnemovirus

UNIT-VI

Hepatitis viruses: types of viral hepatitis Type A Hepatitis (HAV), Type B Hepatitis (HBV), Type C Hepatitis (HCV), Type D Hepatitis (HDV), Type G Hepatitis (HGV)

UNIT-VII

Human Immunodeficiency Virus (HIV)

Structure, Viral Genes and Antigens, Antigenic Variation and Diversity Of HIV, Resistance, Pathogenicity

Acquired Immune Deficiency Syndrome (AIDS)

Clinical features of HIV infection, Laboratory diagnosis, Strategies for HIV testing, Applications of serological tests, Epidemiology and prevention, Prophylaxis, Treatment

Text and Reference Books

S.No.	Name/Title	Author	Publisher
1.	Medical Virology	D.E White & Frank J. Fenner	Elsevier
2.	Principles of virology	F.J Flint et al.	
3.	Medical Virology: A practical Approach	U. Desselberger	Oxford University Press
4.	Textbook of Microbiology	R. Ananthanarayan & C.K. Jayaram Paniker	Universities Press
5.	Textbook of Microbiology	C.P. Baveja	Arya Publications
6.	Essentials in Medical Microbiology	Apurba Sankar Sastry & Sandhya Bhat K	Jaypee Brothers Medical Publishers
7.	Fields Virology	David M. Knipe & Peter M. Howley	Lippincott Williams & Wilkins

Medical Mycology

Course Code	MMLS627
Course Title	Medical Mycology
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	This course is designed to equip postgraduate students in medical laboratory science with advanced knowledge of fungal biology, pathogenesis, host immune response, and modern diagnostic approaches for medical mycology. It emphasises clinically important fungi, emerging fungal infections, antifungal resistance, and laboratory safety in handling fungal pathogens
Course Outcome	At the end of the course, students should be able to **1.** Describe the morphology, classification, and reproductive strategies of medically important fungi. **2.** Explain the pathogenesis of superficial, subcutaneous, systemic, and opportunistic fungal infections. **3.** Evaluate immune responses to fungal pathogens, including innate and adaptive mechanisms. **4.** Apply conventional, biochemical, and molecular techniques for the identification and diagnosis of fungal infections. **5.** Interpret antifungal susceptibility testing and understand resistance mechanisms. **6.** Implement biosafety protocols and quality assurance in mycology laboratories.

UNIT-I

Introduction to Mycology: Characteristics of fungi, classification, laboratory diagnosis, treatment; immune responses to fungal pathogens, antifungal therapy

UNIT-II

Superficial and Subcutaneous Mycosis:

Classification of Mycoses- Superficial Mycoses:

- Surface Mycoses: Pityriasis Versicolor (Tinea Versicolor), Tinea Nigra, Piedra
- Cutaneous Mycoses- Dermatophytoses

Deep Mycoses- Subcutaneous Mycoses: Mycetoma, Chromomycosis, Sporotrichosis, Rhinosporidiosis, Subcutaneous Zygomycosis, Entomophthoromycoses

UNIT-III

Systemic Mycoses: Systemic Mycoses (Dimorphic Fungi), Blastomycosis, Paracoccidioidomycosis, Coccidioidomycosis, Histoplasmosis

UNIT-IV

Opportunistic Mycoses: Aspergillosis, Penicillosis, Zygomycosis (Mucormycosis, Phycomycosis) Candidiasis (Candidiasis, Moniliasis), Cryptococcosis (Torulosis), Pneumocystosis

UNIT-V

Miscellaneous Mycoses: Otomycosis, Oculomycosis (Keratomycosis, Fungal Keratitis, Mycotic Keratitis), Mycotic Poisoning

Text and Reference Books:

S. No	Name	Author(S)	Publisher
1.	Textbook of Medical Mycology,	Jagdish Chander	Jaypee Brothers Medical Publishers
2	Fundamentals of Diagnostic Mycology	George S. Fischer	
3	Essentials in Medical Microbiology	Apurba Sankar Sastry & Sandhya Bhat K	Jaypee Brothers Medical Publishers
4	A guide to study of basic medical mycology	Kee Peng Ng et al.	Kindle Edition
5.	Medical Mycology: A self instructional text	Kathleen S. Blevins	
6.	Fundamental Medical Mycology	Errol Reiss et al.	Wiley-Blackwell

Public Health Microbiology

Course Code	MMLS631
Course Title	Public Health Microbiology
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective(CO)	This course enables to equip students with an insight into antimicrobial Chemotherapy and incidence of antimicrobial resistance. This course also allows for an indepth study of the principles and tools of epidemiology, infection dynamics, and how diseases spread in populations, enabling them to interpret disease patterns and outbreaks. It provides comprehensive insights into sources, types, transmission, and control measures for HCAIs. It also introduces to biomedical waste management and highlights the nature of biological warfare
CourseOutcome	At the conclusion ofthecourse, students will; **1.** Evaluate criteria for the rational selection of antimicrobial drugs, including MIC and therapeutic index. **2.** Analyse how infections establish and progress through stages in the host. **3.** Recognise community-level significant infectious diseases and public health responses. **4.** Describe the role of epidemiologists in epidemic surveillance and control. **5.** Apply standard infection control precautions and preventive practices. **6.** Classify different types of biomedical waste. **7.** Discuss strategies for detection, prevention, and containment of bioterrorismrelated infections.

UNIT-I

Antimicrobial Chemotherapy principles: The origins of antimicrobial drugs, Interaction between drugs and microbes

Major antimicrobial drug groups: Antibacterial drugs that act on the cell wall, antibiotics that damage bacterial cell membrane, Drugs that act on DNA and RNA, Drugs that interfere with protein synthesis, Drugs that block metabolic pathways

Drugs to treat Fungal, Parasitic and viral infections: Antifungal drugs, Antiparasitic Chemotherapy

Interactions between microbes and drugs:

The acquisition of drug resistance

How does Drug resistance develop? Specific mechanisms of

Drug resistance, Natural selection and Drug resistance

Interactions between drugs and Hosts

Toxicity to organs, Allergic responses to drugs, Suppression and Alteration of the microflora by antimicrobials

Considerations in selecting an antimicrobial drug:
Identifying the agent, testing for the susceptibility of microorganisms, The MIC and the therapeutic index, Patient factors in choosing an antimicrobial drug

UNIT-II

Principles of Epidemiology
The science of Epidemiology, The Vocabulary of Epidemiology, Disease reservoirs and Epidemics, Measuring Frequency: The Epidemiologist's Tools

Major factors in the development of an infection:
Phase 1: portals of entry
Phase 2: Attachment to the Host
Phase 3: Invading the Host and becoming established

The Infectious Disease cycle: Recognition of an Infectious disease in a population:
Remote sensing and Geographic Information Systems: Charting infectious diseases, correlation with a single causative agent, Recognition of an epidemic, Infectious disease transmission, The Host Community

The outcomes of Infection and Disease:
The stages of clinical infection, Patterns of infection, Signs and symptoms-warning signals of disease, the portal of exitVacating the Host, The persistence of microbes and pathologic conditions.

UNIT-III

Measures of disease outbreaks:
Procedures used in the investigation of infectious disease outbreaks, Outbreak investigation- team, role of microbiologist in the team, Laboratory diagnosis in public health

Epidemiologically significant infectious diseases in the community

The recent Epidemics: The HIV/AIDS Pandemic, Swine-flu-pandemic (H1N1) 2009 Influenza, SARS as a model of epidemiological success, The COVID pandemic, Healthcare associated infections

Emerging and Reemerging Infectious diseases and pathogens:
Reasons for increases in emerging and reemerging infectious diseases

UNIT-IV

Epidemiology and Public Health: Public health measures for the control of disease, Global Health considerations

Control of Epidemics:
The role of the Public Health Systems: Epidemiological Guardian
Global Travel and Health considerations: Space Travel
Nosocomial Infections, The hospital Epidemiologist

UNIT-V

Healthcare associated infections: Catheter associated UTI, Healthcare -associated bacteremia,

Healthcare associated pneumonia and ventilator associated pneumonia, Healthcare associated wound infections (Surgical site infections) Healthcare associated infections due to Hepatitis viruses B and C (Transfusion-associated infections), Healthcare associated episodes of acute gastroenteritis, Healthcare associated episodes of tetanus

Sources and reservoirs of healthcare associated infections: Endogenous sources of infection, Cross-infection, Infections from environmental sources.

Modes of transmission of microorganisms

Measures to control infection in the healthcare setting:
Standard precautions, Personal protective equipment, Safe injection practices, Environmental cleaning, medical equipment, Respiratory hygiene/Cough etiquette

Precautions in the operating theatre
Investigation and follow-up of outbreaks of disease
Monitoring and regulation of HCAI: Hospital Infection Control Committee

UNIT-VI
Biomedical waste management: Types of biomedical waste

General principles of waste management: Reduction, Segregation, Storage, Transportation, Treatment
Methods of waste management

Waste treatment: Chemical disinfection, Deep burial, Incineration, Autoclaving, Microwaving, Inertisation, Liquid waste disposal

BMW 2016 Rules

UNIT-VII
Bioterrorism and disaster Management:
Definition of bioterrorism, types of bioterrorism agent (CDC Classification), Biological warfare, Global incidents, Role of microorganism in bioterrorism, Emerging pathogen as potential bioweapons, detection, diagnosis, lab safety protocols, biosafet levels and containment.

Phases of disaster management, bioterrorism preparedness and response – Surveillance, warning, emergency response, stockpiling of medicine, decontamination and Quarantine protocols. Use of PPE and infection control, mass casualty management

Text and Reference Books

S. No.	Name/Title	Author	Publisher
1	Epidemiology for Public Health Practice	Robert Friis, Thomas Sellers	Jones & Bartlett Learning
2.	Textbook of Preventive and Social Medicine,	K Park	Banarsidas Bhanot Publishers
3.	Armed Forces Medical College (AFMC) – Textbook of Public Health and Community Medicine	AFMC & WHO India	
4.	Epidemiology: An Introduction,	Kenneth J Rothman	Oxford University Press
5.	Last Public Health and Preventive Medicine,	Robert B. Wallace Maxcy-Rosenau	McGraw-Hill Education
6.	Microbiology,	Prescott, Harley, Klein	McGraw-Hill Education
7.	Epidemiology Principles and Methods	Mac. Mohan & Pugh	Little Brown & Co. Boston. U.S.A
8.	Public Health Administration and Practice	John J. Hanlon	MOSBY
9.	Maxcy-Roseman Public Health and Preventive Medicine	Maxy Roseman John M. Last	Appleton-Century-Crofit, Newyork
10.	Practical Epidemiology	Barker D.J.P.	Churchill Livingstone
11.	The Theory and Practice of Public Health	Hobson W	Oxford Med. Publication
12.	Principles of Medical Statistics	Sir Austin Bradford Hill	The Lancet Ltd. Adelphine, London

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Advances in Microbial Informatics

Course Code	MMLS635
Course Title	Advances in Microbial Informatics
Type of course	Theory
LTP	3 1 0
Credits	4
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	Students will gain foundational knowledge in pharmacokinetics and pharmacodynamics, adverse drug effects, commonly used drugs in infectious and metabolic disorders, and the pharmacology relevant to laboratory diagnostics and interpretation .
Course Outcome	At the end of the course, students should be able to **1.** Explain fundamental concepts of pharmacology **2.** Identify major classes of drugs, their therapeutic uses mechanism of action, and common side effects. **3.** Recognise signs and symptoms of common drug toxicities and the role of the laboratory in monitoring drug therapy.

UNIT-I

Microbial Informatics: Introduction to Bioinformatics, Information flow, Scope of Bioinformatics, computers and microbes, basics of internet, Network-based services (Cloud & Grid Computing), microbial informatics, environment and diversity

UNIT-II

Microbial genomes and data platform: Basics of Database designing and modeling, Designing policies, File formats (FASTA, PIR, Genbank), data storage, retrieval, Microbial Genomes, Genbank, 5 Pfam, KEGG, Brenda, MBGD, biodiversity databases. String comparison, and Smith– Waterman algorithm, BLAST algorithm, FASTA algorithm comparison, Sequence submission tools (Banklt, Sequin).

UNIT-III

- Omics and Microbiome Informatics:
- Types of omics in relation to microbiology.
- Genomics and metagenomics - Gene structure, Gene finding strategies Glimmer, Genscan, promoter region identification, promoter signals, genome annotation tools, Gene ontology, biological networks;
- Proteomics: Protein sequence and structures (primary, secondary and tertiary) and prediction, protparam, Chou– Fasmanalgorithm, GOR method, Concepts of structural modeling and tools PHD, ANOLEA, Transmembrane protein prediction tools, Mass spectrometry data and analysis;
- Transcriptomics and Metabolomics
- Multi-omics- integration of omics and microbial function

UNIT-IV

Phylogenetics and Evolutionary Informatics: Principles of Phylogeny analysis, Phylogenetic reconstruction distance matrix, types of trees, Rooted unrooted, distance-based methods (UPGMA, FM,

NJ Methods), Character based methods (Parsimony method, Maximum likelihood method), tree evaluation, (bootstrapping, Jackknifing), functional inferences. Phylogenetic profiles and functional inference.

UNIT-V

Diagnostic Informatics in Microbiology: Microscopy, Rapid antigen test, PCR, RFLP, Genome sequencing projects, nextgeneration sequencing generation (NGS), Computational tool and pipelines, microarray technology, data analysis methods and tools; Applications in public health diagnostics and outbreak tracking.

UNIT-VI

Antimicrobial Resistance & Comparative Genomics: Phenotypical and genotypical characterisations of resistance formation, application of NGS in studying the resistance mechanisms, mutations, AMR genes, and relevant genes. Comparison of ancestral microbe with mutant bacteria using bioinformatic tools; Ethical and regulatory perspectives in AMR data sharing

Text and Reference Books

S. No.	Name/Title	Author	Publisher
1	Principles of Genome Analysis and Genomics	Sandy B. Primrose, Richard Twyman	Wiley-Blackwell
2.	Transcriptomics and Proteomics,	P.B. Gupta	Elsevier
3.	Microbial Proteomics: Functional Biology of Whole Organisms	Michael Hecker, Ian Humphery-Smith	John Wiley & Sons
4.	Microbial system biology	Alexander	Springer
5.	Molecular Genetics	Stanley R. Maloy, John E. Cronan, Jr., David Freifelder	Jones and Barlett Publishers
6.	Molecular Genetics of Bacteria	Larry Snyder and Wendy Champness	ASM Press, Washington, D.C.
7.	Essentials of Molecular Biology	George M. Malacinski, David Freifelde	Jones and Barlett Publishers
8.	Genomes, Third Edition	T. A. Brown	Wiley-Liss
9.	Bioinformatics: Principles and Applications	Zhumur Ghosh , Bibekanand Mallick	Oxford

Medical Mycology & Virology Practical

Course Code	MMLS629
Course Title	Medical Mycology & Virology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	Students will emphasises clinically important fungi, emerging fungal infections, antifungal resistance, and laboratory safety in handling fungal pathogens. Also develop insight into pathogenicity, diagnosis and prophylaxis of viral infections.
Course Outcome	At the conclusion of The course, Students will : 1. Identify clinically significant fungi & virus that cause human disease. 2. Perform laboratory investigations for the diagnosis of infectious diseases caused by fungi & viruses 3. Interpret antifungal susceptibility testing and understand resistance mechanisms. 4. Apply biosafety and biosecurity principles in the handling of clinical viral specimens and high-risk pathogens 5. Apply conventional, biochemical, and molecular techniques for the identification and diagnosis of fungal & viral infections.

LIST OF PRACTICALS

Medical Mycology

1. Biosafety: Containment practices, disinfectant protocols, PPE adherence
2. Sample Handling: Proper collection, transport media for fungal pathogens
3. Microscopy & Staining: Use of Gram, KOH, Lactophenol Cotton Blue stains; Dalmau slide culture for morphological identification
4. Culture & Identification: Media preparation, incubation, colony morphology, pigment and texture evaluation
5. Antifungal Susceptibility Testing (AFST): Microbroth dilution technique per CLSI guidelines
6. Serological Tests in Mycology: Detection of fungal antigens/antibodies using latex agglutination or ELISA
7. Quality Control & Validation: Reagent preparation, positive/negative controls, documentation standards
8. Clinical Interpretation: Clinical Case Analysis, Interpretation of lab findings in clinical scenarios

Medical Virology

9. Biosafety Practices: Spill management, PPE use, NSI protocols
10. Sample Collection & Handling: Viral transport, documentation, cold-chain maintenance
11. Serological Testing: ELISA, ICT for antigen/antibody detection
12. Molecular Diagnostics: PCR workflow, primer setup, IFA for viral gene localisation
13. Virus Isolation (Demo/Simulation): Cell culture, cytopathic effects observation
14. Interpretation & Reporting: Test result analysis in clinical/outbreak settings
15. Quality Assurance: QA/QC protocols, recordkeeping, equipment calibration
16. Case Analysis: Syndromic profiling, correlation with epidemiological findings

Clinical laboratory rotation/observation can be incorporated wherever possible

Public Health Microbiology Practical

Course Code	MMLS633
Course Title	Public Health Microbiology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. MLT/ BMLS with 50% marks
Course Objective (CO)	The objective of this module is to help the students to understand the course which provide trained manpower, for the sectors needing epidemiologically churning of data for decision making.
Course Outcome	At the conclusion of the course, Students will : 4. Explain the principals of disease,causation with particular emphasis on modifiable environmental factors 5. Encourage the application of epidemiology to the prevention of disease and promotion of health including environmental and occupational health. 6. To ensure that health recourses are used to the best possible effect.

LIST OF PRACTICALS

10. Project: Descriptive Epidemiology of a selected Health Problem
11. Survey Design: Create a Community Health Survey Tool
12. Demonstration: Use of GIS Tools/Software for Disease Mapping (Virtual/Manual)
13. Case Study Analysis of Disease Outbreak
14. Detect presence of potential nosocomial pathogens from swabs collected from inanimate objects in a hospital environment.
15. Segregation and Colour-Coding of Biomedical Waste
16. Demonstration of Waste Treatment Methods
17. Case Study: Anthrax or Other Bioterrorism Events
18. Demonstration/Visit: Public Health Lab or Hospital Epidemiology Unit

Clinical laboratory rotation/observation can be incorporated wherever possible

FOURTH SEMESTER

SEMSTER IV

Course Code	MMLS602
Course Title	Dissertation
Type of course	CC
Credits	22 (990 Hours)
Course prerequisite	B.Sc in MLT/ BMLS with 50% marks
Course Objective (CO)	The students will undergo 5-6 months training to learn about latest techniques used in research
Course Outcome	At the conclusion of the course students will: 1. Understand the research methodology and techniques of experimental work. 2. Develop skill of Scientific writing. 3. Impart proficiency of designing scientific experiments and carry out those experiments

Proforma for submission of M.Sc. MLS dissertation proposal synopsis

1. Name & address of student	
2. Email Id of the student	
3. Registeration number	
4. Name of institute	
5. Title of the dissertation	
6. Name of the guide	
7. Address, phone number and email id of the guide	
8. Designation of the guide	
9. Name of the co-guide	
10. Address, phone number and email id of the Co guide	
11. Designation of the Co-guide	
12. Synopsis of the study Attached (Yes/No)	

Date: Signature of the guide

Enclosures

Synopsis

Proposal /synopsis outline

1. Title
2. Purpose of the study
3. Objectives of the study
4. Operational Definitions
5. Conceptual Framework
6. Assumptions/Hypothesis
7. Research Methodology
    a. Research Approach
    b. Research Design
    c. Setting
    d. Population, Sample & Sampling Technique
    e. Tools &Technique
    f. Pilot study
    g. Plan for data collection
    h. Plan for data analysis
8. Work plan
9. Ethical Considerations
10. References

Guidelines in writing synopsis

1. The research protocol should be of 1200 words (4- 6 pages) on the topic.
2. It should be submitted along with a cover letter.
3. The work and writing of protocol/dissertation should be done under the Guide.
4. The Guide must be as per University norms.
5. The synopsis should be signed by the candidate and forwarded through the Guide, Departmental head and Principal of the Institution.

Date: Signature of the Student

Signature of the Guide Signature of the Principal

Endorsement by the Head of the Institution

The information provided by the teacher is verified from the office records and found to be correct. He/She is eligible to be recognised as a PG teacher to guide the dissertation work of PG students.

Place:

Date: Signature of the Principal/ Dean

Format of the submission of Dissertation Hard & Soft copy

Instructions to candidates

Although your dissertation may be prepared on a computer, consider the following requirements for meeting the standards.

Paper: Use only one side of high-quality, plain white bond paper. Erasable paper should not be used.

Type Size and Print: Select font type Times New Roman and a size of 12 characters. The size of the titles should be 14 and Bold, the size of subtitles should be 12 and Bold. Print should be letter quality or laser printing with dark black characters that are consistently clear and dense. Use the same type of print and print size throughout the document.

Pagination: Number all of the pages of your document, including not only the principle text, but also all plates, tables, diagrams, maps and so on. Roman numerals are used on the preliminary pages (pages up to the first page of text), and Arabic numerals are used on the text pages. The numbers themselves can be placed anywhere on the page; however, they should be consistent.

Spacing: Use double spacing except for long quotations and footnotes, which are singlespaced.

Margins: To allow for binding, the left-hand margin must be 1.5.Other margins should be 1.01. Diagrams or photographs in any form should be a standard page size, or if larger, folded so that a free left-hand margin of 1.5 remains and the folded sheet is not larger than the standard page.

Professional-quality black-and-white photographs are necessary for clear reproduction. Colours are allowed, but you should be certain the colored figure will copy clearly and will not be confusing when printed in black and white.

File Format: Dissertation format should be in Doc (MS Word Document) or PDF (Portable Document Format). Image files in JPG or TIFF format and Audio Visual in AVI (Audio Video Interleave),GIF, MPEG (Moving Picture Expert) files format, Labelling on CD (title, name of the candidate, degree name, subject name, guide name, name of the department, college, place and year.

References: Vancouver style format.

GUIDELINES OF DISSERTATIONS FOR MMLS DEGREE (COVER PAGE)

Title (Capital)

Logo (University/College)

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF MEDICAL LABORATORY SCIENCE (university/College).

Year

Title

By

Name of the Candidate

Dissertation Submitted to the University/College

In partial fulfilment of the requirements for the degree of

Under the guidance of Name of the Guide

Name of the Course

Name of the College

Year

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation/thesis entitled

_____

_____is a bonafide and genuine research work carried out by me under the guidance of (Name and designation of the guide).

Signature of the Candidate

Place:

Date:

CERTIFICATE BY THE GUIDE

This is to certify that this dissertation/thesis entitled_____

is a bonafide and genuine research work done by (Name of the candidate) in partial fulfillment of the requirement for the degree of MMLS.

Signature of the Guide

Name and designation of Guide:

Place:

Date:

ENDORSEMENT BY THE PRINCIPAL/DEAN

This is to certify that this dissertation/thesis entitled_____

is a bonafide and genuine research work done by (Name of the candidate) in partial fulfillment of the requirement for the degree of MMLS.

Seal & Signature of the Principle

Name:

Place:

Date:

Acknowledgement:

Signature of the candidate

Name:

Place:

Date:

Abstract:
Should be structured

(Include background/Introduction and objectives, methodology, results, and conclusion in a single paragraph limited to 250-300 words)

Keywords: 5-6 words

Table of contents

List of Tables: (14 size bold)

List of Figures (14 size bold)

CHAPTER-I

- Introduction (14 size, Bold)
- Sub Headings (12 size, Bold)
- Background of the problem
- Need and significance of the study
- Statement of the problem
- Objectives
- Operational definitions
- Hypothesis
- Conceptual/ theoretical framework

CHAPTER-2 (14 sizes, Bold) Review of literature

- Subheading of the literature reviewed (12sizes, Bold)

CHAPTER-3

- Methodology
- Research approach
- Research design
- Variables
- Schematic representation of the study
- Setting of the study
- Population
- Sample and sampling technique
- Inclusion criteria
- Exclusion criteria
- Tool/instruments
- Development/selection of the tool
- Description of the tool
- Content validity
- Reliability of the tool
- Pilot-study
- Data collection process
- Plan for data analysis

CHAPTER-4 (14sizes,bold)

- Analysis and interpretation
- Section title (Section wise presentation of data)

CHAPTER-5(14sizes,bold)

- Results
- Objectives
- Hypothesis

CHAPTER-6 (14sizes,bold)

- Discussion
- Summary and conclusion
- Implications
- Limitations
- Recommendations

DISSERTATION STYLE: Vancouver style format is used Citations in the text

General Rules:

1. References should be numbered consecutively in the order in which they are cited in the text. Place each reference number in parentheses (5) or as a superscript. Use Arabic numerals if the same references are used again, we use the original number. Square brackets {} or curved Brackets () can be used as long as they are consistent.
2. When multiple references are cited at a given place in a text, use a hyphen to join the first and last numbers that are inclusive (6-9) or use commas (2,6,8,9)
3. Whatever format is chosen, the punctuation must be consistently applied to whole document.

Tables

Tables must be self-explanatory. The data must be clearly organised and should supplement and not duplicate the text. Data may be presented either in a table or pictorial form. Do not use internal horizontal or vertical lines. Explanatory matter should be given as footnotes. Statistical analysis used must be appropriate. Confidence intervals, along with exact probability values, must be stated for the results. Round decimals to two digits. Each table must have a title and should be numbered with Arabic numerical e.g. (1,2). Type or print each table with double spacing on a separate sheet of paper.Number tables consecutively in the order of their first citation in the text and supply a brief title for each. Give each column a Short or an abbreviated heading. Explain all non-standard abbreviations in footnotes. The table should not be carried over to the next page.

Illustrations and figures

- Number each figure in the text in consecutive order
- Abbreviations and symbols: Use only standard abbreviations; the use of nonstandard abbreviations can be confusing to readers. Avoid abbreviations in the title of the manuscripts. The spelt-out abbreviation in parentheses should be used on first mention unless the abbreviation is a standard unit of measurement

Abstract

Abstract provides a summary of the dissertation/thesis, summing up clearly the problem examined, the methods used and the main findings. The abstract is a one-paragraph, self contained summary of the most important elements of the paper. The abstract word limit is between 250 and 300 words. All numbers in the abstract (except those beginning a sentence) should be typed as digits rather than words. Key words (max.6) should be given, chosen from subject concerned headings. Each word should be separated by semicolon.

References

- The reference list should appear at the end of the paper and provide the complete bibliographic information about the sources cited.

- List all reference in order by number, not alphabetically. Each reference is listed once only, since the same number is used throughout the paper. It should be numbered consecutively in the order in which they are first mentioned in the text. Identify references in text and tables by Arabic numerals in parentheses.

- The titles of journals should be abbreviated according to the style used in the list of journals. The following information is included for journal articles: author(s), article, title, abbreviated journal title, year, month (if applicable), day, volume number, issue number (if applicable), and page numbers. For books author(s), title, Edition, place of publication, publisher and year.

- List each author's last name and initials: full first names are not included. List all authors, but if the number exceeds six, give the first six followed by"et al.

- For books with chapters written by individual authors, list the authors of the chapter first, then the chapter title, followed by"In:"the editors' names, and the book title.

- Initials follow the family names of authors and editors, with no space or full stops between the initials of an author, e.g.Halpern SD, Ubel PA, Caplan AI.

- Commas are used to separate each author's name. Note that "and" is not used to separate the last two names.

- Minimal capitalisation is used for the article title, i.e.only the first word and words that normally would begin with a capital letter are capitalised.

- Full stops are used after the last authors initials, after the article title, after the abbreviated journal title and at the end of the entry. Gerald Callee J, Andrew G Fraser, Barrie P Marmion, Anthony Simmons. Mackie & MC Cartney Practical medical microbiology, NewYork, Churchill Livingstone, 1996