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(Accredited by NAAC)

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GU/Acad –PG/BoS -NEP/2025-26/251 Date: 17.07.2025

CIRCULAR

The Academic Council & Executive Council of the University has approved Ordinance OA-35A relating to PG Programmes offered at the University campus and its affiliated Colleges based on UGC 'Curriculum and Credit Framework for Postgraduate Programmes'. Accordingly, the University has proposed introduction of Ordinance OA-35A from the Academic year 2025-2026 onwards.

The Programme structure and syllabus of Semester I and II of the **Post Graduate Diploma in Clinical Genetics and Medical laboratory Techniques (PGDCG & MLT)** Programme approved by the Academic Council in its meeting held on 13th & 14th June 2025 is attached.

The Dean & Vice-Dean (Academic) of the School of Biological Sciences and Biotechnology and Principal of the affiliated College offering the **Post Graduate Diploma in Clinical Genetics and Medical laboratory Techniques (PGDCG & MLT)** are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.07.17 16:44:03 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,
1. The Dean, School of Biological Sciences and Biotechnology, Goa University.
2. The Vice-Dean (Academic), School of Biological Sciences and Biotechnology, Goa University.
3. Principal of affiliated College offering the Post Graduate Diploma in Clinical Genetics and Medical laboratory Techniques (PGDCG & MLT) Programme.

Copy to:
1. Chairperson, BoS in Clinical Genetics & Medical Laboratory Techniques, Goa University.
2. Controller of Examinations, Goa University.
3. Assistant Registrar Examinations (PG), Goa University.
4. Director, Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

GOA UNIVERSITY

POST GRADUATE DIPLOMA IN CLINICAL GENETICS AND MEDICAL LABORATORY TECHNIQUES (PGDCG & MLT)

(Effective from the Academic Year 2025-2026)

ABOUT THE PROGRAMME

The Post Graduate Diploma in Clinical Genetics and Medical Laboratory Techniques (PGDCG & MLT) is a multidisciplinary Programme designed to provide comprehensive training in both theoretical and practical aspects of human genetics and laboratory diagnostics. The Programme aims to bridge the gap between core biological sciences and modern clinical applications, equipping graduates with the knowledge and technical skills essential for roles in clinical laboratories, research institutions, diagnostics, and healthcare facilities.

This one-year diploma Programme is collaboratively offered by Goa University and Goa Medical College, integrating faculty expertise from Zoology, Biochemistry, Microbiology, and Pathology departments. It follows an outcome-based educational framework aligned with the UGC's Curriculum and Credit Framework for Postgraduate Programmes (CCFPP-2023) under Ordinance OA-35A.

Learners are trained through advanced modules covering clinical genetics, biochemistry, microbiology, pathology, parasitology, virology, hematology, and transfusion medicine. Special focus is laboratory management, biomedical safety, diagnostic instrumentation, and quality assurance. Upon completing coursework (40 credits), students undertake a compulsory 6-month internship in government hospital laboratories to gain real-world, hands-on experience.

Approved by: Standing Committee of the Academic Council on 13th & 14th June 2025

OBJECTIVES OF THE PROGRAMME

The Programme is designed to achieve the following objectives:

1. To impart foundational and advanced knowledge in clinical genetics and diagnostic laboratory techniques, emphasizing translational medical applications.
2. To develop technical competencies in students for independent performance of various clinical laboratory procedures across specialties, including biochemistry, microbiology, pathology, parasitology, hematology, and virology.
3. To foster analytical thinking and diagnostic acumen through rigorous training in interpreting laboratory results, understanding disease pathology, and applying genetic principles to clinical contexts.
4. To promote awareness of quality control, laboratory safety, biosecurity, and ethical practices, enabling graduates to operate effectively in accredited diagnostic and research laboratories.
5. To strengthen student capability in handling sophisticated instrumentation in molecular diagnostics, immunoassays, electrophoresis, chromatography, and automation-based clinical tests.
6. To integrate theoretical learning with practical clinical exposure through structured laboratory coursework and supervised hospital-based internships.
7. To prepare graduates for interdisciplinary collaboration, lifelong learning, and possible academic progression in allied health sciences, clinical research, and genetic counselling.

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO 1.	Demonstrate advanced understanding of clinical genetics, medical biochemistry, microbiology, pathology, and hematology, enabling accurate interpretation of laboratory data in a clinical context.
PSO 2.	Operate, calibrate, and maintain modern biomedical laboratory instruments and technologies, ensuring reliable diagnostic test outcomes.
PSO 3.	Apply principles of laboratory safety, biosafety, and quality control standards in accordance with national and international guidelines.
PSO 4.	Collect, handle, analyze, and report clinical specimens, adhering to ethical, legal, and professional standards.
PSO 5.	Interpret genetic and biochemical profiles in relation to patient conditions, contributing meaningfully to multidisciplinary diagnostic teams.
PSO 6.	Demonstrate effective communication, documentation, and decision- making skills, and uphold ethical responsibilities in healthcare and laboratory settings.

PROGRAMME STRUCTURE
Post Graduate Diploma in Clinical Genetics and Medical Laboratory Techniques
Effective from Academic Year 2025-26

Bridge Course			
Sr. No.	**Course Code**	**Title of the Course**	**Credits**
1	MLT-1000	Cell Biology & Genetics	01
2	MLT-1001	Human Body basics and Medical terms	01

Note: Bridge courses will be offered at the beginning of the academic year for admitted students who did not have biological subjects during their B.Sc. Programme, or who had Botany as their major subject in the third year of B.Sc.

SEMESTER I				
Discipline Specific Core (DSC) Courses (16 credits)				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	MLT-5000	Clinical Genetics I	3	400
2	MLT-5001	Laboratory Course on Clinical Genetics I	1	400
3	MLT-5002	Clinical Biochemistry I	3	400
4	MLT-5003	Laboratory Course on Clinical Biochemistry I	1	400
5	MLT-5004	Clinical Microbiology (General & Systematic)	3	400
6	MLT-5005	Laboratory Course on Clinical Microbiology	1	400
7	MLT-5006	Clinical Pathology & Histology	3	400
8	MLT-5007	Laboratory Course on Clinical Pathology & Histology	1	400
Total Credits for DSC Courses in Semester I			**16**	
Discipline Specific Elective (DSE) Course (4 credits)				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	MLT-5201	Laboratory Safety and Biosecurity	02	400
2	MLT-5202	Biostatistics for Laboratory Professionals	02	400
3	MLT-5203	Point-of-Care Testing and Rapid Diagnostics	04	400
4	MLT-5204	Community Health Preventive Diagnostics	02	400
4	Swayam course	Basic Course in Biomedical Research By ICMR-National Institute of Epidemiology (ICMRNIE), Chennai	04	400
5	Swayam course	Introduction to Biomedical Imaging Systems By Prof. Arun K. Thittai | IIT Madras	03	400
6	Swayam course	Biomedical nanotechnology By Prof. P. Gopinath | IIT Roorkee	01	400
7	Swayam course	Biomedical Ultrasound: Fundamentals of Imaging and Micromachined Transducers By Prof. Karla P. Mercado-Shekhar, Prof. Himanshu Shekhar, Prof. Hardik Jeetendra Pandya | IIT Gandhinagar, IISc Bangalore	04	400
Total Credits for DSE Courses in Semester I			**4**	
Total Credits in Semester I			**20**	

SEMESTER II				
Discipline Specific Core (DSC) Courses				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	MLT-5008	Clinical Genetics II	03	500
2	MLT-5009	Laboratory course on Clinical Genetics II	01	500
3	MLT-5010	Clinical Biochemistry II	03	500
4	MLT-5011	Laboratory course on Clinical Biochemistry II	01	500
5	MLT-5012	Clinical Parasitology, Mycology and Virology	03	500
6	MLT-5013	Laboratory course on Clinical Parasitology, Mycology & Virology	01	500
7	MLT-5014	Hematology and Transfusion Medicine	03	500
8	MLT-5015	Laboratory course on Hematology and Transfusion Medicine	01	500
Total Credits for DSC Courses in Semester II			**16**	
Discipline Specific Elective (DSE) Courses (4 credits)				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	MLT-5205	Clinical Laboratory Management and Quality Assurance	02	400
2	MLT-5206	Immunology	02	400
3	MLT-5207	Epidemiology and Outbreak Investigation	04	400
4	MLT-5208	Public health laboratory Practices	02	400
5	Swayam course	Biomedical Instrumentation & Sensors By Dr. Piyush Lotia and Mr. Thaneshwar Kumar Sahu | Chhattisgarh Swami Vivekanand Technical University, Bhilai	04	400
6	Swayam course	Biomedical Signal Processing By Prof. Sudipta Mukhopadhyay | IIT Kharagpur	04	400
7	Swayam course	Food Microbiology and Food Safety By Dr. Tejpal Dhewa | Central University of Haryana	04	400
Total Credits for DSE Courses in Semester II			**4**	
Total Credits in Semester II			**20**	

Blooms Taxonomy Cognitive Levels	
Cognitive Level	**Notations**
K1	Remembering
K2	Understanding
K3	Applying
K4	Analyzing
K5	Evaluating
K6	Create

BRIDGE COURSE

Title of the Course	Cell biology and Genetics
Course Code	MLT-1000
Number of Credits	01
Theory/Practical	Theory
Level	100/200
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value added Course	Yes (Bridge Course)
Course for advanced learners	No

Pre-requisites for the Course:	Nil
Course Objectives:	1. To reinforce and consolidate the understanding of prokaryotic and eukaryotic cell structure and function, with emphasis on major organelles and essential cellular processes. 2. To revisit and strengthen core concepts in molecular biology, focusing on the roles of DNA, RNA, and chromosomes in heredity and gene expression. 3. To refresh foundational knowledge of Mendelian genetics and inheritance patterns, enabling the development of analytical and problem-solving skills. 4. To orient students towards clinically significant genetic disorders and their diagnostic relevance, laying the groundwork for advanced studies in molecular and clinical genetics.

Course Outcomes:			**Mapped to PSO**	
	CO 1. Explain the structural organization and functional roles of key cellular components in prokaryotic and eukaryotic systems. (K2)		PSO1, PSO2	
	CO 2. Summarize the molecular structure and inheritance-related functions of DNA, RNA, and chromosomes in gene expression and regulation. (K2)		PSO1, PSO5	
	CO 3. Apply Mendel's laws to analyze and solve problems related to simple inheritance patterns and genetic crosses. (K3)		PSO1, PSO5	
	CO 4. Identify and analyze common genetic disorders based on inheritance mechanisms, and relate them to clinical or diagnostic applications. (K3)		PSO1, PSO4, PSO5	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Cell Structure and Organelles	1.1 Introduction to Cell Types: Prokaryotic vs. Eukaryotic cells: structure, size, examples, and key differences	**01**	CO1	K2
	1.2 Plasma Membrane: Structure (fluid mosaic model), transport mechanisms (diffusion, osmosis, active)	**01**	CO1	K2
	1.3 Cytoplasmic Organelles: Structure and functions of nucleus, mitochondria, ER, Golgi, lysosomes, peroxisomes	**02**	CO1	K2
	1.4 Cell Cycle and Division: Overview of mitosis and meiosis, significance of cell division, checkpoints	**02**	CO1	K2
Module 2: Basics of Genetics and Inheritance	2.1 DNA, RNA & Chromosomes: Structure and functions of DNA and RNA; packaging of DNA into chromosomes	**01**	CO2	K2
	2.2 Central Dogma: Overview of replication, transcription, and translation	**02**	CO2	K2
	2.3 Mendelian Genetics: Mendel's laws of inheritance, monohybrid and dihybrid crosses	**02**	CO3	K3
	2.4 Genetic Disorders: Examples of autosomal dominant, recessive, and X-linked disorders	**02**	CO3, CO4	K3

Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes
Texts:	1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular biology of the cell* (6th ed.). Garland Science. 2. Arumugam, N. (2016). *Cell biology and genetics* (Revised ed.). Saras Publication. 3. Chaudhuri, S. K. (2018). *Concise medical genetics* (3rd ed.). New Central Book Agency. 4. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (2019). *Introduction to genetic analysis* (12th ed.). W.H. Freeman. 5. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2016). *Molecular cell biology* (8th ed.). W.H. Freeman.
References/ Readings:	1. Adrain, C., & Burbridge, E. (Eds.). (2022). *Organelle homeostasis* [Special issue]. *The FEBS Journal*, *289*(22), 6819–7255. https://doi.org/10.1111/febs.2022.289.issue-22 2. Hallworth, A., & Ventura, J. (2019). Organelle Biology and Medicine. *The Yale Journal of Biology and Medicine*, *92*(3), 367–368. 3. Mukhopadhyay, U., Mandal, T., Chakraborty, M., & Sinha, B. (2024). The Plasma Membrane and Mechanoregulation in Cells. *ACS omega*, *9*(20), 21780–21797. https://doi.org/10.1021/acsomega.4c01962
Web Resources:	1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). *Molecular biology of the cell* (4th ed.). Garland Science. https://www.ncbi.nlm.nih.gov/books/NBK21054/ 2. Cooper, G. M. (2000). *The cell: A molecular approach* (2nd ed.). Sinauer Associates. https://www.ncbi.nlm.nih.gov/books/NBK9839/ 3. UGC–ePG Pathshala. (n.d.). Cell biology module. INFLIBNET. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA==

Title of the Course	Human Body Basics and Medical terms
Course Code	MLT-1001
Number of Credits	01
Theory/Practical	Theory
Level	100/200
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value added Course	Yes (Bridge Course)
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide foundational knowledge of the human body's structural organization and key physiological functions. 2. To introduce students to essential anatomical and directional terms used in medical and laboratory contexts. 3. To enable understanding of the major body systems and their relevance to diagnostic practices. 4. To familiarize learners with common medical terms, abbreviations, and symbols used in healthcare documentation.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Identify the major organs and systems of the human body. (K1)	PSO1
	CO 2. Describe the basic structure and function of major organ systems such as cardiovascular, respiratory, and endocrine systems. (K2)	PSO1, PSO5
	CO 3. Recognize and interpret basic anatomical, directional, and medical terms used in clinical and laboratory settings. (K2)	PSO4, PSO6

	CO 4. Correlate commonly used clinical and diagnostic terms with their associated organ systems and physiological functions. (K3)		PSO5, PSO1, PSO4	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Human Body Systems Overview	1.1: Introduction to human anatomy and body organization	**1**	CO1	K1
	1.2: Overview of skeletal, muscular, and nervous systems	**2**	CO1, CO2	K2
	1.3: Cardiovascular and respiratory systems: basic structure & function	**3**	CO2	K2
	1.4: Digestive, renal, and endocrine systems: organs and relevance	**3**	CO2	K2
Module 2: Medical Terminology Essentials	2.1: Basic anatomical and directional terms	**1**	CO3	K2
	2.2: Terminology related to common body systems	**1**	CO3	K2
	2.3: Abbreviations and symbols in diagnostics	**2**	CO3	K2
	2.4: Correlation of clinical terms with lab reports	**2**	CO4	K3
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Chabner, D. E. (2017). The language of medicine (11th ed.). Elsevier. 2. Ehrlich, A., & Schroeder, C. L. (2021). *Medical terminology for health professions* (8th ed.). Cengage Learning. 3. Martini, F. H., Nath, J. L., & Bartholomew, E. F. (2018). *Fundamentals of anatomy & physiology* (11th ed.). Pearson. 4. Seeley, R. R., Stephens, T. D., & Tate, P. (2016). *Anatomy and physiology* (10th ed.). McGraw-Hill Education. 5. Tortora, G. J., & Derrickson, B. H. (2017). Principles of anatomy and physiology (15th ed.). Wiley. 6. Webster's New World Medical Dictionary. (2008). *Webster's New World medical dictionary* (3rd ed.). Houghton Mifflin Harcourt.			
Web Resources:	1. MedlinePlus. (n.d.). *Anatomy*. U.S. National Library of Medicine. https://medlineplus.gov/anatomy.html 2. MedlinePlus. (n.d.). *Understanding medical words*. U.S. National Library of Medicine. https://medlineplus.gov/medicalwords.html 3. Nandakumar, D. (2024). *Human physiology* [MOOC]. NPTEL – National Programme on Technology Enhanced			

	Learning. https://onlinecourses.nptel.ac.in/noc24_bt05/preview 4. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology* (2nd ed.) [Internet]. Open Resources for Nursing (Open RN). Chippewa Valley Technical College. https://www.ncbi.nlm.nih.gov/books/NBK607454/

SEMESTER I

Discipline Specific Elective Courses

Title of the Course	Clinical genetics-I
Course Code	MLT-5000
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil
Course Objectives:	1. To establish foundational knowledge of classical and molecular genetics, including Mendelian inheritance patterns, gene expression mechanisms, and genetic variations. 2. To examine the genetic basis of single-gene, chromosomal, and polygenic disorders, with emphasis on their clinical implications. 3. To develop the ability to interpret inheritance mechanisms, including autosomal and sex-linked patterns, through structured pedigree analysis. 4. To prepare learners for clinical decision-making by connecting genetic principles with real-world disease examples and diagnostic interpretations.

Course Outcomes:			**Mapped to PSO**	
	CO 1. Explain fundamental concepts of classical genetics, molecular inheritance, and gene expression. *(K2)*		PSO1, PSO5	
	CO 2. Analyze the role of genetic mutations, chromosomal abnormalities, and polygenic inheritance in human disorders. (K4)		PSO1, PSO5	
	CO 3. Interpret standard pedigree charts and identify inheritance patterns such as autosomal dominant, autosomal recessive, and X-linked. (K4)		PSO1, PSO4, PSO5, PSO6	
	CO 4. Correlate clinical case scenarios with genetic principles for accurate interpretation of hereditary conditions. (K5)		PSO1, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Basics of Genetics	1.1: Introduction to genetics: historical overview, key concepts, and terminology	**2**	CO1	K1
	1.2: Mendelian genetics: laws of segregation and independent assortment; inheritance patterns	**5**	CO1, CO2	K2
	1.3: Molecular basis of inheritance: structure/function of DNA & RNA; replication, transcription, translation	**5**	CO1	K2
	1.4: Genetic variation and mutation: types, mutagenic agents, effects on gene function	**3**	CO2	K3
Module 2: Genetic Disorders	2.1: Single-gene disorders: sickle cell anemia, cystic fibrosis, inheritance patterns	**5**	CO2	K2
	2.2: Chromosomal disorders: Down syndrome, Turner syndrome; chromosomal basis and manifestations	**5**	CO2	K3
	2.3: Multifactorial and polygenic disorders: diabetes, heart disease, height, skin colour	**5**	CO2	K3
Module 3: Pedigree Analysis	3.1: Introduction to pedigrees: symbols, family relationships, inheritance types	**4**	CO3	K2
	3.2: Pedigree construction and interpretation: tools, software, case-based learning	**5**	CO3, CO4	K4
	3.3: Genetic diseases with inheritance mapping (e.g., Marfan, CF, hemophilia)	**6**	CO4	K5

Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes
Texts:	1. Arumugam, N., & Meyyan, R. P. (2016). *Advances in Genetics, Volume 1*. Saras Publication. 2. Fitzsimmons, J. S. (1983). *A handbook of clinical genetics*. William Heinemann Medical Books. 3. Gardner, E. J., & Snustad, D. P. (2015). *Principles of Genetics* (8th ed.). Wiley. 4. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (2015). *Introduction to Genetic Analysis* (11th ed.). W.H. Freeman. 5. Klug, W. S., Cummings, M. R., & Spencer, C. A. (2018). *Concepts of Genetics* (12th ed.). Pearson. 6. Read, A., & Donnai, D. (2020). *New clinical genetics* (4th ed.). Scion Publishing Ltd.
References/ Readings:	1. Hochstenbach, R., Liehr, T. & Hastings, R.J. Chromosomes in the genomic age. (2021)Preserving cytogenomic competence of diagnostic genome laboratories. *Eur J Hum Genet* **29**, 541–552. 2. Stevens-Kroef, M., Simons, A., Rack, K., Hastings, R.J. (2017). Cytogenetic Nomenclature and Reporting. In: Wan, T. (eds) Cancer Cytogenetics. Methods in Molecular Biology, vol 1541. Humana Press, New York, NY.
Web Resources:	1. Pollen, A.A., Kilik, U., Lowe, C.B. *et al.* Human-specific genetics: new tools to explore the molecular and cellular basis of human evolution. *Nat Rev Genet* **24**, 687–711 (2023). https://doi.org/10.1038/s41576-022-00568-4 2. Zschocke, J., Byers, P.H. & Wilkie, A.O.M. Mendelian inheritance revisited: dominance and recessiveness in medical genetics. *Nat Rev Genet* **24**, 442–463 (2023).https://doi.org/10.1038/s41576-023-00574-0

Title of the Course	Laboratory Course on Clinical genetics-I
Course Code	MLT-5001
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To enable students to follow safe laboratory practices in handling biological specimens, lab equipment, and hazardous materials according to biomedical protocols. 2. To develop competency in pedigree construction and interpretation, allowing students to analyze inheritance patterns from clinical and familial data. 3. To impart hands-on experience in core molecular genetics techniques including DNA isolation, agarose gel electrophoresis, and band visualization. 4. To build analytical skills required to interpret genetic diagnostic tools such as FISH images, DNA fingerprinting patterns, and clinical genetic reports.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Demonstrate safe laboratory practices, including correct handling of biological materials, equipment, and genetic specimens. *(K2)*	PSO2, PSO4

	CO 2. Construct and analyze pedigree charts to interpret patterns of inheritance and genetic disorders. (K4)		PSO1, PSO4, PSO5	
	CO 3. Perform molecular genetic techniques such as DNA isolation, agarose gel electrophoresis, and visual analysis of genetic material. (K3)		PSO2, PSO4, PSO5	
	CO 4. Interpret laboratory data including gel patterns, FISH images, and clinical genetic reports to identify genetic abnormalities. (K4)		PSO1, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Applied Techniques in Clinical Genetics	1.1. Lab orientation: safety rules, handling biological material, PPE, and waste disposal	**2**	CO1	K2
	1.2. Familiarization with genetic lab equipment and tools	**2**	CO1	K2
	1.3. Specimen procurement: blood sample requisition forms, labeling, and logging	**2**	CO1	K2
	1.4. Pedigree chart basics: symbols, relationships, inheritance types	**2**	CO2	K2
	1.5. Pedigree chart construction from clinical case data	**2**	CO2	K3
	1.6. Pedigree interpretation: autosomal dominant/recessive and X-linked traits	**2**	CO2	K4
	1.7. Case-based pedigree analysis using printed scenarios	**2**	CO2	K4
	1.8. DNA extraction protocol (manual demo or simulation) from blood	**2**	CO3	K3
	1.9. Agarose gel preparation and sample loading for electrophoresis	**2**	CO3	K3
	1.10. Visualization of DNA bands under UV and interpretation of gel results	**2**	CO4	K4
	1.11. Printed DNA fingerprinting patterns: interpretation exercises	**2**	CO4	K4
	1.12. FISH images (printed/simulated): chromosomal aberration identification	**2**	CO4	K4
	1.13. Using pedigree software tools (e.g., Genogram Maker, Progeny Online)	**2**	CO2	K3
	1.14. Simulation-based activity: Identify inheritance types from family trees with clinical traits	**2**	CO2	K4

	1.15. Interpretation of genetic reports (e.g., carrier screening, hemoglobin electrophoresis) with clinical correlation	**2**	CO4	K4
Pedagogy:	Hands-on practical training/ Problem-based learning activities/ demonstrations/Viva-voce			
Texts:	1. Boylan, H. M. (2000). Basic medical laboratory techniques (5th ed.). Cengage Learning. 2. Gangane, S. D. (2023). Human genetics (7th ed., Rev. CBME Curriculum). Elsevier India. (Associate Editor: Shabana Borate) 3. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (2015). Introduction to Genetic Analysis (11th ed.). W.H. Freeman. 4. Klug, W. S., Cummings, M. R., & Spencer, C. A. (2018). Concepts of Genetics (12th ed.). Pearson. 5. Sambrook, J., & Russell, D. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.). Cold Spring Harbor Laboratory Press. 6. Strachan, T., & Read, A. (2018). Human Molecular Genetics (5th ed.). Garland Science. 7. Wilson, K., & Walker, J. (2010). *Principles and techniques of biochemistry and molecular biology* (7th ed.). Cambridge University Press.			
References/ Readings:	1. Hochstenbach, R., Liehr, T. & Hastings, R.J. Chromosomes in the genomic age. (2021)Preserving cytogenomic competence of diagnostic genome laboratories. *Eur J Hum Genet* **29**, 541–552. 2. Stevens-Kroef, M., Simons, A., Rack, K., Hastings, R.J. (2017). Cytogenetic Nomenclature and Reporting. In: Wan, T. (eds) Cancer Cytogenetics. Methods in Molecular Biology, vol 1541. Humana Press, New York, NY.			
Web Resources:	1. Pollen, A.A., Kilik, U., Lowe, C.B. *et al.* Human-specific genetics: new tools to explore the molecular and cellular basis of human evolution. *Nat Rev Genet* **24**, 687–711 (2023). https://doi.org/10.1038/s41576-022-00568-4 2. Zschocke, J., Byers, P.H. & Wilkie, A.O.M. Mendelian inheritance revisited: dominance and recessiveness in medical genetics. *Nat Rev Genet* **24**, 442–463 (2023). https://doi.org/10.1038/s41576-023-00574-0			

Title of the Course	Clinical Biochemistry-I
Course Code	MLT-5002
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide foundational knowledge of cell biology and physical chemistry, including cellular structure, subcellular components, and concepts like pH, buffers, and acid–base balance relevant to clinical settings. 2. To explain the chemistry, classification, and biomedical relevance of carbohydrates, lipids, proteins, and hemoglobin, with emphasis on their physiological and diagnostic importance. 3. To enable understanding of enzyme function, regulation, and diagnostic value, along with the biochemical role of coenzymes and isoenzymes in metabolism. 4. To describe the classification, dietary sources, physiological roles, and clinical implications of vitamins and minerals, with a focus on deficiency states and biochemical disorders.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Describe the structure and functions of eukaryotic cells, organelles, cell membranes, and the significance of pH, buffers, and acid-base metabolism in biological systems. *(K2)*	PSO1, PSO5

	CO 2. Classify and explain the chemistry, sources, and biomedical roles of carbohydrates, lipids, proteins, and hemoglobin. (K2)		PSO1, PSO5	
	CO 3. Analyze the functional significance of enzymes, including their classification, coenzymes, and diagnostic applications. (K4)		PSO1, PSO4, PSO5	
	CO 4. Identify the sources, functions, and deficiency-related disorders of essential vitamins and minerals in relation to human physiology. (K3)		PSO1, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Cellular Organization, Acid-Base Balance, Carbohydrates and Lipids	1.1: Cell: Definition, structure of eukaryotic cells, organelles and their functions	**2**	CO1	K2
	1.2: Subcellular fractionation, cell markers, and cell membrane structure and function	**2**	CO1	K3
	1.3: pH, hydrogen ion concentration, buffer systems, and acid-base metabolism	**2**	CO1	K3
	1.4: Blood buffer systems and regulation of blood pH	**2**	CO1	K3
	1.5: Carbohydrates – Definition, classification, sources, functions, and biomedical importance	**3**	CO2	K2
	1.6: Lipids – Definition, classification, essential fatty acids, prostaglandins, phospholipids, lipoproteins, cholesterol	**4**	CO2	K2
Module 2: Proteins, Hemoglobin and enzymes	2.1: Proteins and amino acids – Classification, essential and biologically important amino acids, peptides	**2**	CO2	K2
	2.2: Structure, functions of proteins and plasma proteins	**2**	CO2	K3
	2.3: Hemoglobin – Structure, functions, synthesis and breakdown, abnormal hemoglobins	**4**	CO2	K3
	2.4: Enzymes – Definition, classification, coenzymes, factors affecting activity, enzyme inhibition, isoenzymes, diagnostic value	**7**	CO3	K4
Module 3: Vitamins, and Minerals	3.1: Vitamins – Classification, dietary sources, functions, deficiency symptoms (A, D, E, K, C, B1, B6, B12, Folic Acid)	**8**	CO4	K3
	3.2: Minerals – Sources, absorption, functions, disorders of Ca, P, Mg, Cu, Fe, I, Zn	**7**	CO4	K3

Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes
Texts:	1. Jain, J. L., Jain, S., & Jain, N. (2016). *Fundamentals of biochemistry* (6th ed.). S. Chand Publishing. 2. Kamat, G. (2011). *Practical manual of hematology*. Jaypee Brothers Medical Publishers Pvt Ltd. 3. Lieberman, M. A., & Ricer, R. (2019). *BRS biochemistry, molecular biology, and genetics*. (8th ed.). Wolters Kluwer. 4. Mukherjee, K. L. (2017). *Medical laboratory technology: Volume II* (2nd ed.). Tata McGraw-Hill Publishing Company Ltd. 5. Naik, P. (2019). *Medical biochemistry*. (6th ed.). Jaypee Brothers Medical Publishers. 6. Nelson, D. L., & Cox, M. M. (2019). *Lehninger's principles of biochemistry* (8th ed.). Wiki Publications. 7. Sood, R. (2015). *Medical laboratory technology* (2nd ed.). Jaypee Brothers Medical Publishers Pvt Ltd. 8. Vasudevan, D. M. (2015). *Textbook of biochemistry for medical students* (10th ed.). Jaypee Brothers Medical Publishers.
References/ Readings:	1. Dashty M. (2013). A quick look at biochemistry: carbohydrate metabolism. *Clinical biochemistry*, *46*(15), 1339–1352. 2. Niharika, Garg, M. (2024). Techniques for the Identification and Characterization of Biomolecules. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 3. Panini, R. S. (2013). *Medical biochemistry: An illustrated review*. Thieme Medical Publishers. 4. Shafi, S., Khan, H., Bajpai, P. (2024). Protein Metabolism and Its Profiling for the Diagnosis of Metabolic Disorders. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 5. Singh, P.K. *et al.* (2024). Enzymes and Their Clinical Applications. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore.
Web Resources:	1. INFLIBNET Centre. (n.d.). *Biochemistry – e-Adhyayan eBooks*. https://ebooks.inflibnet.ac.in/eadhyayan/site/genre?id=Biochemistry 2. Kumar, J. B., Goud, B. K. M., & Kumar, A. (2021). Liver function tests: Biochemical overview for clinical correlation. *Indian Journal of Medical Biochemistry*, *25*(1), 31–37. https://doi.org/10.5005/jp-journals-10054- 0171 3. Lippi, G., von Meyer, A., Cadamuro, J., & Simundic, A. M. (2019). Blood sample quality. *Diagnosis (Berlin, Germany)*, *6*(1), 25–31. https://doi.org/10.1515/dx-2018-0018

Title of the Course	Laboratory Course on Clinical Biochemistry-I
Course Code	MLT-5003
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To train students in the qualitative and quantitative analysis of biomolecules, including carbohydrates, proteins, and lipids using standard biochemical methods. 2. To provide hands-on experience in the estimation of clinically important parameters such as serum calcium, chloride, inorganic phosphorus, and cholesterol using manual and automated techniques. 3. To familiarize learners with modern analytical instrumentation, including colorimeters, autoanalyzers, electrophoresis units, and chromatography techniques. 4. To develop skills in interpreting clinical biochemistry results, including A/G ratio, and relate findings to health and disease contexts.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Perform qualitative tests for carbohydrates, proteins, and lipids using standard biochemical reagents and observe characteristic reactions. *(K3)*	PSO2, PSO4

	CO 2. Estimate and interpret levels of clinically relevant biochemical parameters such as serum calcium, chloride, phosphorus, proteins, and cholesterol. (K4)		PSO1, PSO4, PSO5	
	CO 3. Operate laboratory instruments including colorimeters, electrophoresis apparatus, chromatography setups, and autoanalyzers with appropriate calibration and safety. (K3)		PSO2, PSO6	
	CO 4. Analyze biochemical lab findings to support diagnosis and distinguish normal from pathological ranges in clinical case scenarios. (K4)		PSO1, PSO5, PSO6	
Content:	**Topics**	**No. of Hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Clinical Biochemistry Laboratory Practices	**1.1.** Qualitative carbohydrate chemistry – Monosaccharides	**2**	CO1	K3
	1.2. Qualitative carbohydrate chemistry – Disaccharides	**2**	CO1	K3
	1.3. Qualitative carbohydrate chemistry – Polysaccharides	**2**	CO1	K3
	1.4. Qualitative protein chemistry – Colour reactions and precipitation	**2**	CO1	K3
	1.5. Qualitative protein chemistry – Albumin/Globulin, Casein & Gelatin	**2**	CO1	K3
	1.6. Qualitative lipid chemistry & estimation of cholesterol	**2**	CO2	K4
	1.7. Estimation of serum proteins and A/G ratio	**2**	CO2	K4
	1.8. Estimation of chloride in serum & Demonstration: Estimation of pH, use of pH meter	**2**	CO2	K4
	1.9. Estimation of serum calcium	**2**	CO2	K4
	1.10. Estimation of serum inorganic phosphorus	**2**	CO2	K4
	1.11. Demonstration: Chromatography (e.g., paper/TLC)	**2**	CO3	K3
	1.12. Demonstration: Electrophoresis	**2**	CO3	K3
	1.13. Demonstration: Colorimeter – principle and use	**2**	CO3	K3
	1.14. Demonstration: Autoanalyzer – introduction, workflow and Errors in Laboratory	**2**	CO3	K3
	1.15. Final revision and viva-based discussion	**2**	CO4	K4

Pedagogy:	Hands-on practical training/ Problem-based learning activities/ demonstrations/Viva-voce
Texts:	1. Jain, J. L., Jain, S., & Jain, N. (2016). *Fundamentals of Biochemistry* (7th ed.). S. Chand Publishing. 2. Kamat, G. (2011). *Practical Manual of Hematology*. Jaypee Brothers Medical Publishers Pvt Ltd. 3. Lieberman, M. A., & Ricer, R. (2019). *BRS Biochemistry, Molecular Biology, and Genetics*. (8th ed.). Wolters Kluwer. 4. Mukherjee, K. L. (2017). *Medical Laboratory Technology – Vol II*. (4th ed.). Tata McGraw-Hill Publishing Company Ltd. 5. Naik, P. (2019). *Medical Biochemistry*. (6th ed.). Jaypee Brothers Medical Publishers. 6. Sood, R. (2015). *Medical Laboratory Technology* (6th ed.). Jaypee Brothers Medical Publishers Pvt Ltd. 7. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2016). *Textbook of Biochemistry for Medical Students* (10th ed.). Jaypee Brothers Medical Publishers.
References/ Readings:	1. Dashty M. (2013). A quick look at biochemistry: carbohydrate metabolism. *Clinical biochemistry*, *46*(15), 1339– 1352. 2. Niharika, Garg, M. (2024). Techniques for the Identification and Characterization of Biomolecules. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 3. Panini, R. S. (2013). *Medical biochemistry: An illustrated review*. Thieme Medical Publishers. 4. Shafi, S., Khan, H., Bajpai, P. (2024). Protein Metabolism and Its Profiling for the Diagnosis of Metabolic Disorders. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 5. Singh, P.K. *et al.* (2024). Enzymes and Their Clinical Applications. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore.
Web Resources:	1. INFLIBNET Centre. (n.d.). *Biochemistry – e-Adhyayan eBooks*. https://ebooks.inflibnet.ac.in/eadhyayan/site/genre?id=Biochemistry 2. Kumar, J. B., Goud, B. K. M., & Kumar, A. (2021). Liver function tests: Biochemical overview for clinical correlation. *Indian Journal of Medical Biochemistry*, *25*(1), 31–37. https://doi.org/10.5005/jp-journals-10054-0171 3. Lippi, G., von Meyer, A., Cadamuro, J., & Simundic, A. M. (2019). Blood sample quality. *Diagnosis (Berlin, Germany)*, *6*(1), 25–31. https://doi.org/10.1515/dx-2018-0018

Title of the Course	Clinical Microbiology (General & Systematic)
Course Code	MLT-5004
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce students to the fundamental concepts and laboratory methods of microbiology, including microbial classification, culture techniques, sterilization, and quality control procedures relevant to clinical settings. 2. To provide knowledge and technical understanding of serological reactions, including antigen-antibody interactions, bacterial identification methods (morphological, biochemical, molecular), and safety protocols in microbiological diagnostics. 3. To familiarize learners with diagnostic tools and automated systems (e.g., MALDI-TOF, VITEK 2, PCR) used in identifying clinically significant pathogens. 4. To develop competency in identifying and differentiating systemic bacterial pathogens, including their morphology, cultural features, biochemical characteristics, and roles in common infectious diseases.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Describe the classification, structure, and basic characteristics of clinically relevant bacteria	PSO1, PSO4

	and explain principles of sterilization, culture media, and infection control. *(K2)*			
	CO 2. Apply methods of serological testing and interpret antigen-antibody reactions in bacterial identification and diagnostic microbiology. (K3)		PSO1, PSO5	
	CO 3. Analyze biochemical, morphological, and molecular techniques for identifying bacteria, including use of automated systems such as PCR, MALDI-TOF, and VITEK 2. (K4)		PSO2, PSO4, PSO5	
	CO 4. Identify and differentiate systemic bacterial pathogens based on diagnostic features, laboratory behavior, and clinical relevance. (K4)		PSO1, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Introduction to Microbiology	1.1: Historical perspective; principles and types of microscopes	**2**	CO1	K2
	1.2: Classification, anatomy, and reproduction of bacteria; growth curve	**3**	CO1	K2
	1.3: Sterilization methods – physical and chemical	**3**	CO1	K3
	1.4: Culture media – types, constituents, preparation	**2**	CO1	K3
	1.5: pH, inoculation, culture methods, antimicrobial sensitivity testing	**2**	CO1	K3
	1.6: Hospital-acquired infections, BMW, inventory/stock management, and QC in microbiology	**3**	CO1	K3
Module 2: Serology	2.1: Antigen-antibody reaction, agglutination, precipitation, and flow cytometry	**3**	CO2	K3
	2.2: Morphological and biochemical methods of bacterial identification	**3**	CO2	K3
	2.3: Molecular methods (PCR, LAMP, Biofilm Array)	**3**	CO3	K4
	2.4: Automated systems for bacterial identification (e.g., MALDI- TOF, VITEK 2)	**3**	CO3	K4
	2.5: Automated culture techniques and standard precautions	**3**	CO3	K3
Module 3: Systemic (Individual	3.1: Diagnosis and lab features of Staphylococcus, Streptococcus, Pneumococcus	**3**	CO4	K4
	3.2: Corynebacterium, Clostridia, Neisseria	**3**	CO4	K4

Bacteria)	3.3: Escherichia coli, Klebsiella, Salmonella, Shigella	**3**	CO4	K4
	3.4: Proteus, Pseudomonas	**2**	CO4	K4
	3.5: Mycobacterium tuberculosis, Treponema pallidum	**4**	CO4	K4
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Baveja, C. P., & Baveja, V. (2021). *Complete Microbiology*. Avichal Publishing Company. 2. Brooks, G. F., Carroll, K. C., Butel, J. S., & Morse, S. A. (2016). *Jawetz, Melnick & Adelberg's Medical Microbiology* (27th ed.). McGraw Hill. 3. Cheesbrough, M. (2006). *District Laboratory Practice in Tropical Countries: Part 2* (2nd ed.). Cambridge University Press. 4. Collee, J. G., Duguid, J. P., Fraser, A. G., & Marmion, B. P. (2007). *Mackie & McCartney Practical Medical Microbiology* (14th ed.). Churchill Livingstone. 5. Kanungo, R., & Saxena, S. (Eds.). (2022). *Ananthanarayan and Paniker's Textbook of Microbiology* (11th ed.). Universities Press (India). 6. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). *Textbook of Diagnostic Microbiology* (5th ed.). Elsevier Health Sciences. 7. Sastry, A. S., & Bhat, S. (2019). *Essentials of Medical Microbiology* (2nd ed.). Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Ferrusca Bernal, D., Mosqueda, J., Pérez-Sánchez, G., Chávez, J. A. C., Neri Martínez, M., Rodríguez, A., & Carvajal-Gamez, B. (2024). Loop-Mediated Isothermal Amplification Coupled with Reverse Line Blot Hybridization for the Detection of *Pseudomonas aeruginosa*. *Microorganisms*, *12*(11), 2316. 2. Gieroń, M., Żarnowiec, P., Zegadło, K., Gmiter, D., Czerwonka, G., Kaca, W., & Kręcisz, B. (2023). Loop- Mediated Isothermal Amplification of DNA (LAMP) as an Alternative Method for Determining Bacteria in Wound Infections. *International journal of molecular sciences*, *25*(1), 411. 3. Guo, L., Ye, L., Zhao, Q., Ma, Y., Yang, J., & Luo, Y. (2014). Comparative study of MALDI-TOF MS and VITEK 2 in bacteria identification. *Journal of thoracic disease*, *6*(5), 534–538 4. Habets, M. N., van Selm, S., van der Gaast-de Jongh, C. E., Diavatopoulos, D. A., & de Jonge, M. I. (2017). A novel flow cytometry-based assay for the quantification of antibody-dependent pneumococcal			

	agglutination. *PloS one*, *12*(3), e0170884.
Web Resources:	1. NCBI Bookshelf. (n.d.). *Medical Microbiology (Baron et al.) – 4th ed.* https://www.ncbi.nlm.nih.gov/books/NBK7627/

Title of the Course	Laboratory Course on Clinical Microbiology
Course Code	MLT-5005
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To train students in the qualitative and quantitative analysis of biomolecules, including carbohydrates, proteins, and lipids using standard biochemical methods. 2. To provide hands-on experience in the estimation of clinically important parameters such as serum calcium, chloride, inorganic phosphorus, and cholesterol using manual and automated techniques. 3. To familiarize learners with modern analytical instrumentation, including colorimeters, autoanalyzers, electrophoresis units, and chromatography techniques. 4. To develop skills in interpreting clinical biochemistry results, including A/G ratio, and relate findings to health and disease contexts.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Demonstrate the ability to prepare clinical smears, apply staining techniques (e.g., Gram, Ziehl-Neelsen), and interpret microscopic findings in bacterial specimens. (K3)	PSO1, PSO2

	CO 2. Operate and maintain laboratory equipment, including microscopes and sterilizers, and explain the working principles and applications in microbial diagnostics. (K3)		PSO2, PSO4	
	CO 3. Perform bacterial culture, inoculation, identification, and antimicrobial sensitivity testing using clinical specimens. (K4)		PSO1, PSO4, PSO5	
	CO 4. Follow laboratory safety protocols, biomedical waste disposal procedures, and documentation standards in clinical microbiology labs. (K3)		PSO4, PSO6	
Content:	**Topics**	**No. of Hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Clinical Microbiology Laboratory Practices	**1.1.** Preparation of smears for staining and fixation from samples and culture media (liquid and solid)	**2**	CO1	K3
	1.2. Care and use of microscopes (including fluorescent microscope)	**2**	CO2	K3
	1.3. Staining techniques – Gram, Ziehl-Neelsen, Fluorescent staining: preparation, procedure, and reporting	**2**	CO1	K3
	1.4. Equipment used in sterilization – structure, principle, types, autoclaves, advantages, limitations	**2**	CO2	K3
	1.5. Culture media – types, constituents, preparation, pH adjustment, sterilization	**2**	CO2	K3
	1.6. Culture techniques – inoculation from clinical samples and subculturing	**2**	CO3	K4
	1.7. Antimicrobial sensitivity testing	**2**	CO3	K4
	1.8. Preparation of wet mount and motility observation	**2**	CO3	K3
	1.9. Identification of bacteria – morphological and biochemical	**2**	CO3	K4
	1.10. Antigen-antibody reactions (demonstration-based serology)	**2**	CO3	K3
	1.11. Biomedical waste management	**2**	CO4	K3
	1.12. Standard precautions and infection control practices	**2**	CO4	K3
	1.13. Systemic bacteriology – demonstration of diagnostic features of major bacterial	**2**	CO3	K4

	classes			
	1.14. Practical review session – correlation of test findings with case scenarios	**2**	CO4	K4
	1.15. Final viva, feedback, and session wrap-up	**2**	CO4	K4
Pedagogy:	Hands-on practical training/ Problem-based learning activities/ demonstrations/Viva-voce			
Texts:	1. Baveja, C. P., & Baveja, V. (2021). Complete Microbiology. Avichal Publishing Company. 2. Brooks, G. F., Carroll, K. C., Butel, J. S., & Morse, S. A. (2016). Jawetz, Melnick & Adelberg's Medical Microbiology (27th ed.). McGraw-Hill Education. 3. Cappuccino, J. G., & Welsh, C. (2019). Microbiology: A Laboratory Manual (12th ed.). Pearson. 4. Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries – Part 2 (2nd ed.). Cambridge University Press. 5. Collee, J. G., Duguid, J. P., Fraser, A. G., & Marmion, B. P. (2007). Mackie & McCartney Practical Medical Microbiology (14th ed.). Churchill Livingstone. 6. Dubey, R. C., & Maheshwari, D. K. (2015). A Textbook of Microbiology (Revised ed.). S. Chand Publishing. 7. Forbes, B. A., Sahm, D. F., & Weissfeld, A. S. (2007). Bailey & Scott's Diagnostic Microbiology (12th ed.). Mosby Elsevier. 8. Greenwood, D., Slack, R., & Peutherer, J. (2012). Medical Microbiology: A Guide to Microbial Infections (18th ed.). Elsevier. 9. Kanungo, R., & Saxena, S. (Eds.). (2022). Ananthanarayan and Paniker's Textbook of Microbiology (11th ed.). Universities Press (India). 10. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). Textbook of Diagnostic Microbiology (5th ed.). Elsevier Health Sciences. 11. Salle, A. J. (2000). Fundamental Principles of Bacteriology (7th ed.). Tata McGraw-Hill. 12. Sastry, A. S., & Bhat, S. (2019). Essentials of Medical Microbiology (2nd ed.). Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Jhaveri TA, Weiss ZF, Winkler ML, Pyden AD, Basu SS, Pecora ND. A decade of clinical microbiology: top 10 advances in 10 years: what every infection preventionist and antimicrobial steward should know. Antimicrobial Stewardship & Healthcare Epidemiology. 2024;4(1):e8. 2. Ramana, K. V. (2014). Molecular Diagnostic Methods and Their Application to Patient Care: Clinical			

	Microbiologist's Perspective. American Journal of Clinical Medicine Research, 2(1), 8-13.
Web Resources:	1. Microbiology Society. (n.d.). Education and outreach resources. Retrieved June 7, 2025, from https://microbiologysociety.org/resources/education-and-outreach-resources.html 2. WHO Laboratory Manual. (n.d.). Manual for the Laboratory Diagnosis of Bacterial Pathogens. https://apps.who.int/iris/handle/10665/68357

Title of the Course	Clinical Pathology and Histology
Course Code	MLT-5006
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To develop foundational knowledge and technical proficiency in histopathological techniques, including fixation, processing, staining (routine and special), and sectioning of tissues for diagnostic interpretation. 2. To train students in the clinical examination and analysis of various body fluids, such as urine, stool, semen, sputum, and cerebrospinal fluid, through both physical/chemical methods and microscopic evaluations. 3. To impart essential cytological techniques such as exfoliative cytology, FNAC, and cytological staining, while introducing automation and advanced sample processing for enhanced diagnostic accuracy. 4. To familiarize learners with advanced histotechnology tools, including enzyme histochemistry, immunohistochemistry, tissue microarray, and molecular techniques such as FISH and in situ hybridization used in modern pathology laboratories.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Demonstrate understanding of tissue processing, fixation, and staining techniques, including	PSO1, PSO2

	routine and special histological stains. *(K2)*			
	CO 2. Apply techniques for the examination of body fluids (urine, stool, semen, CSF, sputum) using physical, chemical, and microscopic methods for diagnostic purposes. (K3)		PSO1, PSO4	
	CO 3. Analyze cytological samples using exfoliative cytology and FNAC techniques, and interpret cytological stains including Papanicolaou, H&E, and MGG. (K4)		PSO1, PSO5	
	CO 4. Evaluate the application of advanced diagnostic technologies including enzyme histochemistry, immunohistochemistry, tissue microarrays, and molecular techniques like FISH and in situ hybridization. (K5)		PSO2, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Histopathological Techniques	1.1.: Fixatives: types, preparation, examples (e.g., formalin, Zenker's, Bouin's) and their applications	**2**	CO1	K2
	1.2.: Tissue processing: dehydration, clearing, embedding, microtomy, decalcification methods	**3**	CO1	K3
	1.3.: Routine and special staining: theory, classification of dyes, hematoxylins, and their derivatives	**3**	CO1	K3
	1.4.: Special stains for carbohydrates, lipids, pigments, minerals, connective tissue, and microorganisms	**4**	CO1	K4
	1.5.: Automation in histology: frozen sectioning, mounting media, automatic processors, and staining systems	**3**	CO1	K3
Module 2: Examination of Body Fluids	2.1.: Collection and handling of body fluids (urine, stool, semen, sputum)	**2**	CO2	K3
	2.2.: Physical, chemical, and microscopic examination of urine and stool	**3**	CO2	K4
	2.3.: Semen analysis and sperm motility; pregnancy tests	**3**	CO2	K3
	2.4.: Sputum examination and detection of pathological features	**3**	CO2	K3

	2.5.: Laboratory diagnosis of kidney disorders from urine/blood findings	**4**	CO2	K4
Module 3: Cytological Techniques &	3.1.: Exfoliative cytology, fixation techniques, and Pap staining	**3**	CO3	K3
	3.2.: Fine needle aspiration cytology (FNAC): procedure and staining (H&E, MGG)	**3**	CO3	K4
Molecular Applications	3.3.: CSF, pleural, peritoneal, and synovial fluid examination	**3**	CO3	K3
	3.4.: Quality control and automation in clinical pathology labs	**2**	CO4	K4
	3.5.: Immunohistochemistry, enzyme histochemistry, tissue microarrays, in situ hybridization, and FISH	**4**	CO4	K5
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Bancroft, J. D., & Layton, C. (2019). *Theory and Practice of Histological Techniques* (8th ed.). Elsevier. 2. Chakraborty, P. (2009). *A Textbook of Microbiology* (2nd ed.). New Central Book Agency. 3. Chatterjee, M. N. (2013). *Textbook of Medical Biochemistry* (8th ed.). Jaypee Brothers Medical Publishers. 4. Dereck, A. C., & Cameron, I. R. (2019). *Histopathology Specimens: Clinical, Pathological and Laboratory Aspects*. Springer. 5. Dey, P. (2014). *Basic and Advanced Laboratory Techniques in Histopathology and Cytology*. Springer. 6. Kawthalkar, S. M. (2018). *Essentials of Clinical Pathology* (2nd ed.). Jaypee Brothers Medical Publishers. 7. Kiernan, J. A. (2008). *Histological and Histochemical Methods: Theory and Practice* (4th ed.). Scion Publishing. 8. Lieberman, M. A., & Ricer, R. (2019). *BRS Biochemistry, Molecular Biology and Genetics*. Lippincott Williams & Wilkins. 9. Mohan, H. (2017). *Practical Pathology* (2nd ed.). Jaypee Medical Publishers. 10. Mukherjee, K. L. (2017). *Medical Laboratory Technology*. Tata McGraw-Hill Publishing Company Ltd. 11. Sood, R. (2009). *Medical Laboratory Technology* (2nd ed.). Jaypee Brothers Medical Publishers. 12. Vasudevan, D. M. (2013). *Textbook of Biochemistry for Medical Students* (7th ed.). Jaypee Brothers Medical Publishers.			
References/	1. Azhar, R., & Misra, A. (2017). Steps of tissue processing in histopathology laboratory: Review report. *Journal of*			

Readings:	*Pharmaceutical Sciences and Research*, 9(6), 774–776. 2. Esteves, S. C., & Agarwal, A. (2021). A review of semen analysis: Updates from the WHO sixth edition. *Asian Journal of Andrology*, 23(5), 459–467. 3. Ramos-Vara, J. A. (2011). Principles and methods of immunohistochemistry. *Veterinary Pathology*, 48(1), 42– 87. 4. Sandhya, V. (2023). A review on automation in histopathology laboratory. *International Journal of Allied Medical Sciences and Clinical Research*, 11(3), 421–426. 5. Sciacovelli, L., O'Kane, M., Skaik, Y., & Plebani, M. (2017). Quality indicators in laboratory medicine: From theory to practice. *Biochemia Medica*, 27(2), 321–329. 6. Simerville, J. A., Maxted, W. C., & Pahira, J. J. (2005). Urinalysis: A comprehensive review. *American Family Physician*, 71(6), 1153–1162. https://www.aafp.org/pubs/afp/issues/2005/0315/p1153.html 7. Singh, A. (2021). Tissue fixatives: A review. *International Journal of Medical Science and Diagnosis Research*, 5(3), 14–17. https://media.neliti.com/media/publications/409291-tissue-fixatives-a-review- 3abe0b3a.pdf 8. Singh, A., & Shukla, S. (2015). Fine needle aspiration cytology: Principles and practice. *International Journal of Pathology and Clinical Research*, 1(1), 5–10. 9. Trask, B. J. (2014). Fluorescence in situ hybridization (FISH). *Current Protocols in Human Genetics*, 63(1), A.1.1–A.1.6.
Web Resources:	1. Leica Biosystems. (n.d.). *An introduction to specimen processing*. https://www.leicabiosystems.com/us/knowledge-pathway/an-introduction-to-specimen-processing/ 2. Paskoski, N. (2020, October 6). *Types of histology fixatives*. National Society for Histotechnology. https://www.nsh.org/blogs/natalie-paskoski/2020/10/06/types-of-histology-fixativesnsh.org

Title of the Course	Laboratory Course on Clinical Pathology & Histology
Course Code	MLT-5007
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To impart hands-on training in core histopathological techniques including tissue fixation, dehydration, embedding, microtomy, and staining procedures used in diagnostic histology laboratories. 2. To develop technical competence in the physical, chemical, and microscopic examination of body fluids such as urine, CSF, sputum, stool, semen, and serous fluids, using both manual and automated methods. 3. To familiarize students with cytological techniques, including exfoliative cytology and FNAC, along with preparation and staining of cytological specimens using standard protocols. 4. To introduce advanced histopathological tools and instrumentation, including microscopes (e.g., phase contrast, fluorescence), biopsy needles, cryostats, automated processors, and quality control procedures in clinical practice.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Perform tissue fixation, processing, embedding, and section cutting using manual and automated microtomy techniques. *(K3)*	PSO1, PSO2

	CO 2. Execute routine and special histological staining methods (e.g., H&E, PAS, Masson's trichrome, Verhoeff's) and identify common staining errors. (K4)		PSO1, PSO4	
	CO 3. Analyze various body fluids (urine, CSF, stool, semen, sputum, and serous fluids) using physical, chemical, and microscopic methods. (K4)		PSO1, PSO4, PSO5	
	CO 4. Demonstrate cytological specimen preparation, staining, and examination through exfoliative cytology and FNAC techniques. (K3)		PSO1, PSO5	
Content:	**Topics**	**No. of Hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Practical Skills in Clinical Pathology & Histology	**1.1.** Tissue fixation, dehydration, clearing, impregnation, embedding, decalcification	**2**	CO1	K3
	1.2. Use of microtome (rocking, sliding, rotary), autotechnicon, paraffin bath	**2**	CO1	K3
	1.3. Microtome knives: sharpening, handling, cutting errors; cryostat and frozen sectioning	**2**	CO1	K3
	1.4. Routine staining: Hematoxylin and Eosin (H&E)	**2**	CO2	K3
	1.5. Special stains: PAS, Verhoeff's, Masson's Trichrome, Von Giessons, fat stains	**2**	CO2	K4
	1.6.: Grossing and museum techniques	**2**	CO1	K3
	1.7.: Urine examination: physical and chemical tests	**2**	CO3	K3
	1.8.: Urine examination: reagent strips, Esbach's, urinometer, dipstick readers, automated urine analyzers	**2**	CO3	K4
	1.9.: Pregnancy tests	**1**	CO3	K3
	1.10.: CSF and body cavity fluids (pleural, peritoneal, synovial)	**2**	CO3	K4
	1.11.: Sputum and stool examination	**2**	CO3	K3
	1.12.: Semen analysis	**2**	CO3	K3
	1.13.: Exfoliative cytology: Pap staining	**2**	CO4	K3
	1.14.: FNAC procedure: smear prep, H&E, and MGG staining	**2**	CO4	K3

	1.15.: Instruments: compound, phase contrast, dark ground, fluorescent, and polarizing microscopes	**2**	CO5	K3
Pedagogy:	Hands-on practical training/ Problem-based learning activities/ Viva-voce			
Texts:	1. Bancroft, J. D., & Layton, C. (2019). *Theory and Practice of Histological Techniques* (8th ed.). Elsevier. 2. Dereck, A. C., & Cameron, I. R. (2019). *Histopathology Specimens: Clinical, Pathological and Laboratory Aspects*. Springer. 3. Dey, P. (2014). *Basic and Advanced Laboratory Techniques in Histopathology and Cytology*. Springer. 4. Lieberman, M. A., & Ricer, R. (2019). *BRS Biochemistry, Molecular Biology and Genetics*. Lippincott Williams & Wilkins. 5. Mohan, H. (2017). *Practical Pathology*. Jaypee Brothers Medical Publishers. 6. Mukherjee, K. L. (2017). *Medical Laboratory Technology*. Tata McGraw-Hill Publishing Company Ltd. 7. Prophet, E. B., Mills, B., Arrington, J. B., & Sobin, L. H. (1994). *Laboratory Methods in Histotechnology*. American Registry of Pathology. 8. Sood, R. (2009). *Medical Laboratory Technology* (2nd ed.). Jaypee Brothers Medical Publishers 9. Vasudevan, D. M. (2013). *Textbook of Biochemistry for Medical Students* (7th ed.). Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Azhar, R., & Misra, A. (2017). Steps of tissue processing in histopathology laboratory: Review report. *Journal of Pharmaceutical Sciences and Research*, 9(6), 774–776. 2. Esteves, S. C., & Agarwal, A. (2021). A review of semen analysis: Updates from the WHO sixth edition. *Asian Journal of Andrology*, 23(5), 459–467. 3. Ramos-Vara, J. A. (2011). Principles and methods of immunohistochemistry. *Veterinary Pathology*, 48(1), 42–87. 4. Sandhya, V. (2023). A review on automation in histopathology laboratory. *International Journal of Allied Medical Sciences and Clinical Research*, 11(3), 421–426. 5. Sciacovelli, L., O'Kane, M., Skaik, Y., & Plebani, M. (2017). Quality indicators in laboratory medicine: From theory to practice. *Biochemia Medica*, 27(2), 321–329. 6. Simerville, J. A., Maxted, W. C., & Pahira, J. J. (2005). Urinalysis: A comprehensive review. *American Family Physician*, 71(6), 1153–1162. https://www.aafp.org/pubs/afp/issues/2005/0315/p1153.html			

	7. Singh, A. (2021). Tissue fixatives: A review. *International Journal of Medical Science and Diagnosis Research*, 5(3), 14–17. https://media.neliti.com/media/publications/409291-tissue- fixatives-a-review-3abe0b3a.pdf 8. Singh, A., & Shukla, S. (2015). Fine needle aspiration cytology: Principles and practice. *International Journal of Pathology and Clinical Research*, 1(1), 5–10. 9. Trask, B. J. (2014). Fluorescence in situ hybridization (FISH). *Current Protocols in Human Genetics*, 63(1), A.1.1–A.1.6.
Web Resources:	1. Leica Biosystems. (n.d.). *An introduction to specimen processing*. https://www.leicabiosystems.com/us/knowledge-pathway/an-introduction-to-specimen- processing/ 2. Paskoski, N. (2020, October 6). *Types of histology fixatives*. National Society for Histotechnology. https://www.nsh.org/blogs/natalie-paskoski/2020/10/06/types-of-histology- fixativesnsh.orgSingh, A., & Shukla, S. (2015). Fine needle aspiration cytology: Principles and practice. *International Journal of Pathology and Clinical Research*, 1(1), 5–10. 3. Trask, B. J. (2014). Fluorescence in situ hybridization (FISH). *Current Protocols in Human Genetics*, 63(1), A.1.1–A.1.6.

Discipline Specific Elective Courses

Title of the Course	Laboratory Safety and Biosecurity
Course Code	MLT-5201
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide foundational knowledge of laboratory safety principles and good laboratory practices (GLP) necessary for safe handling of biological, chemical, and physical hazards in medical laboratory settings. 2. To train students in risk assessment methodologies and mitigation strategies**,** including the proper use of personal protective equipment (PPE), specimen handling, and emergency response protocols. 3. To develop a clear understanding of biosecurity concepts, national regulations, and security frameworks for preventing unauthorized access, misuse, or accidental release of biological materials in clinical and research laboratories. 4. To build competency in implementing chemical, biological, and waste management systems, and in ensuring secure transport, containment, and incident response for hazardous materials under regulatory compliance.	
Course Outcomes:		**Mapped to PSO**

	CO 1. Explain the principles of laboratory safety, good laboratory practices (GLP), and the classification of hazards and associated risks in clinical and research laboratories. *(K2)*		PSO1, PSO4	
	CO 2. Apply safety protocols for the use of personal protective equipment (PPE), chemical handling, biological containment, and emergency preparedness procedures. (K3)		PSO2, PSO4	
	CO 3. Analyze biosecurity threats, national guidelines, and access control strategies to safeguard laboratory personnel, biological materials, and sensitive assets. (K4)		PSO4, PSO6	
	CO 4. Evaluate waste management systems, incident reporting frameworks, and transport security mechanisms for biohazardous materials in compliance with regulatory standards. (K5)		PSO4, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Laboratory Safety	1.1: Introduction to laboratory safety: GLP, hazards, risks	**2**	CO1	K2
	1.2: Hazard identification: biological, chemical, physical; risk assessment and mitigation	**2**	CO1	K2
	1.3: Personal protective equipment (PPE): types, selection, usage	**2**	CO2	K3
	1.4: Safe lab practices: specimen handling, instrument use, safety protocols	**2**	CO2	K3
	1.5: Emergency preparedness: response plans, first aid techniques	**2**	CO2	K3
	1.6: Chemical safety and management: storage, labeling, spill response	**2**	CO2	K3
	1.7: Biological safety: infectious specimen handling, biosafety levels, decontamination	**2**	CO2	K3
	1.8: Waste management: segregation, labeling, disposal, environmental and legal compliance	**1**	CO4	K5
Module 2: Biosecurity	2.1: Introduction to biosecurity: definitions, risks, vulnerabilities	**2**	CO3	K4
	2.2: National biosecurity guidelines: regulations, acts, and standards	**3**	CO3	K4
	2.3: Personnel biosecurity: access control, background checks, training	**3**	CO3	K4
	2.4: Incident response: reporting, containment, documentation	**2**	CO4	K5
	2.5: Physical security and facility access: surveillance, restricted access	**2**	CO3	K4

	2.6: Transport security: packaging, chain of custody, compliance with transport laws	**3**	CO4	K5
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Burnette, R. N. (Ed.). (2021). *Applied Biosecurity: Global Health, Biodefense, and Developing Technologies*. Springer 2. CDC. (2020). *Biosafety in Microbiological and Biomedical Laboratories (BMBL)* (6th ed.). U.S. DHHS. 3. Frontiers Media SA. (n.d.). *Frontiers Books in Biosafety and Biosecurity*. Lausanne: Frontiers Media SA. 4. Reynolds, M. G., & Hynes, N. A. (2007). *Laboratory Biosecurity Handbook*. CRC Press. 5. Sood, R. (2009). *Medical Laboratory Technology* (2nd ed.). Jaypee Brothers Medical Publishers. 6. Vesley, D., & Hart, B. (2019). *Laboratory Safety for Chemistry Students* (2nd ed.). Wiley. 7. WHO. (2006). *Laboratory Biosecurity Guidance*. Geneva: World Health Organization. 8. WHO. (2021). *Laboratory Biosafety Manual* (4th ed.). Geneva: World Health Organization. 9. Wilson, D. E., & Chosewood, L. C. (2017). *Biological Safety: Principles and Practices* (5th ed.). Wiley.			
References/ Readings:	1. ICMR. (2021). *National Guidelines for Biomedical and Health Research Involving Human Participants*. New Delhi: Indian Council of Medical Research. 2. NIH. (2020). *Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules*.			
Web Resources:	1. World Health Organization. (2020). *Laboratory biosafety manual* (4th ed.). https://www.who.int/publications/i/item/9789240011311			

Title of the Course	Biostatistics for Laboratory Professionals
Course Code	MLT-5202
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce the fundamental concepts and scope of biostatistics and highlight its application in laboratory diagnostics and medical research, especially in interpreting test performance and disease patterns. 2. To develop competency in classifying and summarizing different types of laboratory data, using descriptive statistics and probability distributions for accurate analysis and reporting. 3. To enable learners to apply appropriate statistical tests (parametric and nonparametric) for hypothesis testing, group comparisons, and association analysis in a clinical laboratory setting. 4. To equip students with statistical tools for advanced data interpretation, including correlation, regression, ANOVA, and survival analysis relevant to patient outcomes and laboratory-based investigation.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Describe the foundational concepts of biostatistics, types of data, and measurement scales used in clinical laboratory settings. *(K2)*	PSO1, PSO5

	CO 2. Apply descriptive statistics and probability distributions to summarize and interpret laboratory data accurately. (K3)		PSO1, PSO5	
	CO 3. Analyze laboratory data using appropriate statistical tests (e.g., t-tests, chi-square, Mann-Whitney U) to assess differences, associations, and test validity. (K4)		PSO1, PSO4, PSO5	
	CO 4. Evaluate relationships and trends in biomedical datasets using correlation, regression, ANOVA, and survival analysis to inform diagnostic decisions. (K5)		PSO1, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Basic Concepts in Biostatistics	1.1: Introduction to biostatistics: role in laboratory practice, research, and diagnostics	**3**	CO1	K2
	1.2: Types of data and measurement scales: nominal, ordinal, interval, ratio	**3**	CO1	K2
	1.3: Descriptive statistics: mean, median, mode, variance, SD	**3**	CO2	K3
	1.4: Probability distributions: normal, binomial, examples from lab scenarios	**3**	CO2	K3
	1.5: Sampling methods: simple random, stratified, systematic	**3**	CO2	K3
Module 2: Statistical Analysis in Laboratory Practice	2.1: Parametric and nonparametric tests: t-tests, chi-square, Mann-Whitney U	**3**	CO3	K4
	2.2: Correlation and regression: Pearson's r, simple linear regression	**3**	CO4	K4
	2.3: ANOVA: One-way and two-way analysis	**3**	CO4	K5
	2.4: Survival analysis: Kaplan-Meier curves and log-rank test	**3**	CO4	K5
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes.			
Texts:	1. Daniel, W. W., & Cross, C. L. (2018). *Biostatistics: A Foundation for Analysis in the Health Sciences* (11th ed.). Wiley. 2. Mahajan, B. K. (2019). *Methods in Biostatistics for Medical Students and Research Workers* (9th ed.). Jaypee Brothers Medical Publishers. 3. Rosner, B. (2020). *Fundamentals of Biostatistics* (8th ed.). Cengage Learning.			

	4. Glantz, S. A. (2012). *Primer of Biostatistics* (7th ed.). McGraw-Hill. 5. Pagano, M., & Gauvreau, K. (2018). *Principles of Biostatistics* (2nd ed.). CRC Press. 6. Das, A. K. (2015). *Biostatistics for Medical Students and Researchers*. Academic Publishers. 7. Khan, I. A., & Khanum, A. (2004). *Fundamentals of Biostatistics*. Ukaaz Publications. 8. Goon, A. M., Gupta, M. K., & Dasgupta, B. (2013). *Fundamentals of Statistics* (Vol. I & II). World Press. 9. Rao, K. Visweswara (2009). *Biostatistics: A Manual of Statistical Methods for Use in Health, Nutrition and Anthropology*. Jaypee Brothers Medical Publishers.

Title of the Course	Point-of-Care Testing and Rapid Diagnostics
Course Code	MLT-5203
Number of Credits	4
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To build a comprehensive understanding among students regarding the principles, scope, and clinical applications of point-of-care testing in diagnostic medicine. 2. To enable students to develop proficiency in the selection, operation, and interpretation of various POCT devices and rapid diagnostic platforms. 3. To ensure that students acquire the necessary competencies in quality assurance, biosafety measures, and regulatory compliance specific to POCT practices. 4. To engage students in critical analysis of emerging technologies, ethical frameworks, and the practical deployment of POCT in institutional and field-based healthcare environments..	
Course Outcomes:	At the end of the course learner will be able to	**Mapped to PSO**
	CO 1. Describe the principles, classification, and clinical significance of POCT.(K2)	PSO1, PSO5
	CO 2. Demonstrate the ability to identify and interpret results from POCT devices. (K3)	PSO2, PSO5

	CO 3. Apply biosafety and quality assurance measures relevant to POCT operations. (K3)		PSO2, PSO3	
	CO 4. Analyze emerging POCT technologies and their application in community and emergency settings. (K4)		PSO1, PSO5, PSO6	
	CO 5. Evaluate ethical and regulatory aspects of POCT implementation. (K5)		PSO3, PSO4, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Fundamentals and Types of POCT	1.1. Concept, evolution, and importance of POCT	**1**	CO1	K2
	1.2. Classification: Qualitative vs. Quantitative, screening vs. confirmatory	**2**	CO1	K2
	1.3. Devices in routine use: Glucometer, urine strip test, pregnancy kits, HbA1c, lipid profile	**4**	CO2	K3
	1.4. POCT for cardiovascular and renal markers: Troponin, BNP, Creatinine, microalbumin	**3**	CO2	K3
	1.5. POCT in endocrinology: TSH, cortisol, LH kits	**3**	CO2	K3
	1.6. Result interpretation, false positives/negatives, operator errors	**2**	CO2	K3
Module 2: POCT for Infectious Diseases and Emergency Medicine	2.1 Lateral flow assays for dengue, malaria, COVID-19, HIV, HBsAg, HCV	**3**	CO2	K3
	2.2 POCT in pandemics, ICUs, and trauma units	**3**	CO4	K4
	2.3 Specimen collection for POCT: capillary blood, swabs, saliva, urine	**2**	CO3	K3
	2.4 Handling POCT in remote and rural settings: logistics, transport, mobile kits	**2**	CO4	K4
	2.5 Cold chain, sample stability, biosafety & infection control at POCT sites	**3**	CO3	K3
	2.6 Role of POCT in outbreak investigation & screening camps	**2**	CO3	K3
Module 3: Quality Management, Biosafety & Emerging POCT Technologies	3.1 Quality Assurance: IQC, EQC, internal audits for POCT	**3**	CO3	K3
	3.2 Equipment calibration, maintenance, and troubleshooting	**2**	CO3	K3
	3.3 Biosafety guidelines, PPE, disposal of POCT wastes	**2**	CO3	K3
	3.4 CRISPR-based POCT (SHERLOCK, DETECTR),	**3**	CO4	K4

	microfluidics, wearable sensors			
	3.5 Smartphone-based diagnostics and AI-integrated POCT	**2**	CO4	K4
	3.6 Validating new POCTs: Sensitivity, specificity, reproducibility	**3**	CO4	K4
Module 4: Regulatory, Ethical, and Translational Aspects of POCT	4.1 Regulatory frameworks: ISO 22870, NABL norms, CDSCO, IVD regulation	**3**	CO5	K5
	4.2 Ethical concerns: Consent, data privacy, false reassurance, risk communication	**2**	CO5	K5
	4.3 Lab accreditation and POCT: Responsibilities of operators and supervisors	**2**	CO5	K5
	4.4 POCT in community health: PHCs, school screening, anemia detection	**3**	CO4	K4
	4.5 Case studies: TB screening, antenatal kits, COVID-19 rapid response units	**3**	CO4	K4
	4.6 Future of POCT: Integration with telemedicine and eHealth platforms	**2**	CO4	K4
	4.7 Regulatory frameworks: ISO 22870, NABL norms, CDSCO, IVD regulation	**3**	CO5	K5
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. ISO 22870:2016 – *Point-of-Care Testing (POCT) – Requirements for Quality and Competence.* 2. Nichols, J.H. (2020). *Point-of-Care Testing: Principles and Clinical Applications*. Springer. 3. WHO (2020). *Technical Specifications for Essential In Vitro Diagnostics at Point-of-Care.*			
References/ Readings:	1. Aborode, A. T., Adesola, R. O., Scott, G. Y., Arthur-Hayford, E., Otorkpa, O. J., Kwaku, S. D., Elebesunu, E. E., Nibokun, E. O., Aruorivwooghene, I. J., Bakre, A. A., Ogundijo, O. A., Banwo, O. G., Ige, O., Adelakun, I. O., Onifade, I. A., Ogungbemi, S. E., Dosunmu, B. T., Ayando, O. D., Idowu, N., Adegoye, G. A., … Jimoh, O. O. (2025). Bringing lab to the field: Exploring innovations in point-of-care diagnostics for the rapid detection and management of tropical diseases in resource-limited settings. *Advances in Biomarker Sciences and Technology, 7*, 28–43. 2. Gupta, N., Augustine, S., Narayan, T., O'Riordan, A., Das, A., Kumar, D., Luong, J. H. T., & Malhotra, B. D. (2021). Point-of-Care PCR Assays for COVID-19 Detection. *Biosensors*, *11*(5), 141. 3. Silva, L. D. C., Silva, D. M. F. D., Calassa, I. M. C., De Curcio, J. S., Costa, L. H. A., de Sousa, F. B., Anunciação, C. E., & Silveira-Lacerda, E. P. (2025). Fast and visual RT-LAMP assay for detection of oropouche virus. *European journal of clinical microbiology & infectious diseases : official publication of the European Society of Clinical*			

	Microbiology, 10.1007/s10096-025-05174-w. 4. Whiting, P., Al, M., Westwood, M., Ramos, I. C., Ryder, S., Armstrong, N., Misso, K., Ross, J., Severens, J., & Kleijnen, J. (2015). Viscoelastic point-of-care testing to assist with the diagnosis, management and monitoring of haemostasis: a systematic review and cost-effectiveness analysis. *Health technology assessment (Winchester, England)*, *19*(58), 1–vi. https://doi.org/10.3310/hta19580
Web Resources:	1. *Tropical Infectious Diseases* – POCT and rapid diagnostics in clinical use https://www.ncbi.nlm.nih.gov/books/NBK8538/ 2. *Tietz Clinical Chemistry* – Utility of POCT in lab medicine https://www.ncbi.nlm.nih.gov/books/NBK557667/ 3. *Medical Microbiology* – Basics of infectious disease diagnostics https://pubs.rsc.org/en/content/articlehtml/2023/sd/d3sd00092c 4. https://www.ncbi.nlm.nih.gov/books/NBK7627/ 5. Chen, H., Liu, K., Li, Z., & Wang, P. (2019). Point of care testing for infectious diseases. *Clinica chimica acta; international journal of clinical chemistry*, *493*, 138–147. https://doi.org/10.1016/j.cca.2019.03.008 6. Larkins, M. C., & Thombare, A. (2023). Point-of-Care Testing. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK592387/ 7. *Point-of-Care Tests for Infectious Diseases: A Review of Clinical and Cost-Effectiveness, and Guidelines*. (2016). Canadian Agency for Drugs and Technologies in Health. Point-of-Care Tests for Infectious Diseases: A Review of Clinical and Cost-Effectiveness, and Guidelines - NCBI Bookshelf

Title of the Course	Community Health and Preventive Diagnostics
Course Code	MLT-5204
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To develop an understanding of the diagnostic laboratory's role in the promotion of community health and disease prevention strategies. 2. To build student competencies in screening programs, preventive diagnostics, and outreach-based sample handling and interpretation. 3. To encourage student awareness about national health programs, primary healthcare delivery systems, and preventive laboratory testing. 4. To examine practical and ethical aspects of public health diagnostics and patient-centered education in low- resource settings.	
Course Outcomes:	At the end of the course learner will be able to	**Mapped to PSO**
	CO 1. Describ e the role of laboratory diagnostics in community health and national disease control strategies. (K2)	PSO1, PSO5
	CO 2. Apply basic principles of preventive testing in screening for common diseases. (K3)	PSO2, PSO4

	CO 3. Identify public health indicators through laboratory markers and interpret them in community health contexts. (K4)		PSO2, PSO5	
	CO 4. Recognize ethical, logistical, and communicative elements in the deployment of preventive diagnostics. (K4)		PSO4, PSO6	
	CO 5. Describe the role of laboratory diagnostics in community health and national disease control strategies. (K2)		PSO1, PSO5	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Principles of Epidemiology	1.1. Concepts of community health, public health vs. individual health, preventive care levels	**2**	CO1	K2
	1.2. Common community health challenges: anemia, malnutrition, tuberculosis, diabetes, STIs, hypertension	**3**	CO1	K2
	1.3. Public health screening vs. diagnostic testing: criteria, sensitivity, specificity, cost-effectiveness	**3**	CO2	K3
	1.4. National Health Programs using diagnostics: RNTCP, IDSP, NPCDCS, anemia mukt bharat, immunization tracking	**4**	CO1	K2
	1.5. Health education, IEC strategies, and the lab professional's role in community health campaigns	**3**	CO4	K4
Module 2: Surveillance Systems and Data Interpretation	2.1. Lab-based screening tests: hemoglobin estimation, blood glucose, urine sugar/protein, rapid HBsAg, malaria, HIV card tests	**4**	CO2	K3
	2.2. Sample collection in outreach settings: DBS (dried blood spot), finger-prick, field biosafety, labeling, transport	**3**	CO2	K3
	2.3. Analysis of community-level lab reports: prevalence studies, anemia profiles, endemic disease surveillance	**3**	CO3	K4
	2.4. Ethics in community diagnostics: consent, privacy, false positives, stigma, follow-up care	**2**	CO4	K4
	2.5. Case studies: School health checkups, rural anemia screening, camp-based hepatitis detection	**3**	CO3	K4

	2.6. Concepts of community health, public health vs. individual health, preventive care levels	**2**	CO1	K2
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Ministry of Health and Family Welfare. (n.d.). ASHA training modules: Modules 1–7 and updated guidelines. Government of India. 2. Park, K. (2023). Park's textbook of preventive and social medicine (27th ed.). Jabalpur, India: Banarsidas Bhanot Publishers. 3. Zaza, S., Briss, P. A., & Harris, K. W. (Eds.). (2005). The guide to community preventive services: What works to promote health? Oxford University Press. 4. Bedi, Y. P. (Ed.). (2023). Handbook of preventive and social medicine (17th ed.). CBS Publishers & Distributors Pvt. Ltd.			
References/ Readings:	1. Pimple, S. A., & Mishra, G. A. (2019). Global strategies for cervical cancer prevention and screening. Minerva ginecologica, 71(4), 313–320. 2. Summerbell, C. D., Waters, E., Edmunds, L. D., Kelly, S., Brown, T., & Campbell, K. J. (2005). Interventions for preventing obesity in children. The Cochrane database of systematic reviews, (3), CD001871. 3. Gérvas, J., Oliver, L. L., & Pérez-Fernandez, M. (2020). Family and Community Medicine and its role in preventing health overuse (preventive, diagnostic, therapeutic and rehabilitative). Medicina de Familia y Comunidad y su papel en evitar los excesos sanitarios (preventivos, diagnósticos, terapéuticos y rehabilitadores). Ciencia & saude coletiva, 25(4), 1233–1240. 4. Henderson, A., & Nimmo, G. R. (2018). Control of healthcare- and community-associated MRSA: recent progress and persisting challenges. British medical bulletin, 125(1), 25–41. https://doi.org/10.1093/bmb/ldx046			
Web Resources:	1. Alaofè, H., Asaolu, I., Ehiri, J., Moretz, H., Asuzu, C., Balogun, M., Abosede, O., & Ehiri, J. (2017). Community Health Workers in Diabetes Prevention and Management in Developing Countries. Annals of global health, 83(3-4), 661–675. https://doi.org/10.1016/j.aogh.2017.10.009 2. Mahalmani, V. M., Mahendru, D., Semwal, A., Kaur, S., Kaur, H., Sarma, P., Prakash, A., & Medhi, B. (2020). COVID-19 pandemic: A review based on current evidence. Indian journal of pharmacology, 52(2), 117–129. https://doi.org/10.4103/ijp.IJP_310_20			

SEMESTER II

Discipline Specific Core Courses

Title of the Course	Clinical genetics-II
Course Code	MLT-5008
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-5000 Clinical Genetics-I
Course Objectives:	1. To provide an advanced understanding of molecular genetic techniques and their applications in clinical diagnostics, including PCR, FISH, and DNA fingerprinting. 2. To explore the genetic basis of cancer and dermatoglyphic patterns, emphasizing molecular mechanisms, gene-environment interactions, and diagnostic correlations. 3. To train students in the principles and practices of human karyotyping, including chromosomal classification, staining techniques, and banding analysis used in detecting genetic abnormalities. 4. To develop foundational competencies in genetic counselling and diagnosis, incorporating concepts from the Human Genome Project and modern prenatal and preimplantation testing methods.

Course Outcomes:			**Mapped to PSO**	
	CO 1. Apply molecular genetic techniques such as blotting, PCR, RFLP, FISH, and DNA sequencing in the context of clinical diagnostics and genetic profiling. *(K3)*		PSO1, PSO2, PSO5	
	CO 2. Analyze the genetic mechanisms involved in cancer development and interpret dermatoglyphic patterns associated with clinical disorders. (K4)		PSO1, PSO5	
	CO 3. Evaluate karyotyping procedures, chromosome banding techniques, and metaphase preparations for identifying chromosomal abnormalities. (K5)		PSO1, PSO4	
	CO 4. Demonstrate an understanding of the Human Genome Project and apply genetic counseling protocols including prenatal and preimplantation diagnostic methods. (K3)		PSO5, PSO6	
	CO 5. Apply molecular genetic techniques such as blotting, PCR, RFLP, FISH, and DNA sequencing in the context of clinical diagnostics and genetic profiling. (K3)		PSO1, PSO2, PSO5	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module I: Molecular Genetics, Genetics of Cancer, and Dermatoglyphics	1.1: Molecular genetic techniques: Southern, Northern, Western blotting, PCR, RFLP, FISH, sequencing	**5**	CO1	K3
	1.2: DNA fingerprinting and its clinical applications	**2**	CO1	K3
	1.3: Genetics of cancer: characteristics, oncogenes, tumor suppressor genes, environment, and genome use	**4**	CO2	K4
	1.4: Dermatoglyphics: types, clinical applications, advantages and limitations	**4**	CO2	K4
Module 2: Karyotyping in Clinical Genetics	2.1: Introduction to karyotyping, chromosome classification and nomenclature	**2**	CO3	K2
	2.2: Sample preparation, cell culture for metaphase spreads	**3**	CO3	K3
	2.3: Chromosome staining methods: Giemsa, Q-banding, C- banding	**4**	CO3	K4
	2.4: Special banding techniques: NOR, R-banding, T-banding	**3**	CO3	K4
Module 3: Human	3.1: Human Genome Project: background, goals, impact	**3**	CO4	K2

Genome Project, Genetic Diagnosis and Counselling	3.2: Preimplantation and prenatal diagnosis: amniocentesis, CVS, fetoscopy, ultrasonography	**4**	CO4	K3
	3.3: Genetic counseling process: history, pedigree, clinical exam, diagnosis, communication, follow-up	**5**	CO4	K3
	3.4: Ethical and social issues in genetic testing and counseling	**3**	CO4	K4
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes.			
Texts:	1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science. 2. Borgaonkar, D. S. (2011). *Medical Genetics Made Easy* (2nd ed.). Jaypee Brothers Medical Publishers. 3. Cummins, H., & Midlo, C. (1961). *Fingerprints, Palms, and Soles: An Introduction to Dermatoglyphics*. Dover Publications. 4. Rooney, D. E., & Czepulkowski, B. H. (2001). *Human Cytogenetics: Constitutional Analysis* (3rd ed.). Oxford University Press. 5. Strachan, T., & Read, A. P. (2018). *Human Molecular Genetics* (5th ed.). Garland Science. 6. Thompson, M. W., Thompson, J. S., & McInnes, R. R. (2019). *Thompson & Thompson Genetics in Medicine* (9th ed.). Elsevier. 7. Turnpenny, P. D., & Ellard, S. (2016). *Emery's Elements of Medical Genetics* (15th ed.). Elsevier. 8. Weinberg, R. A. (2014). *The Biology of Cancer* (2nd ed.). Garland Science.			
References/ Readings:	1. Gardner, R. J. M., & Sutherland, G. R. (2004). *Chromosome abnormalities and genetic counseling* (3rd ed.). Oxford University Press. 2. Shaffer, L. G., & Slovak, M. L. (2006). *An international system for human cytogenetic nomenclature (ISCN)*. S. Karger.			
Web Resources:	1. Collins, F. S., Morgan, M., & Patrinos, A. (2003). The Human Genome Project: Lessons from large-scale biology. *Science, 300*(5617), 286–290. https://doi.org/10.1126/science.1084564 2. Knoppers, B. M., & Chadwick, R. (2005). Human genetic research: Emerging trends in ethics. *Nature Reviews Genetics, 6*(1), 75–79. https://doi.org/10.1038/nrg1496			

Title of the Course	Laboratory Course on Clinical genetics-II
Course Code	MLT-5009
Number of Credits	1
Theory/Practical	Practical
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-5001 Laboratory Course on Clinical Genetics-I	
Course Objectives:	1. To develop practical proficiency in preparing and handling cell culture media, setting up peripheral blood cultures, and executing harvesting techniques for chromosomal analysis. 2. To introduce students to advanced cytogenetic techniques including metaphase plate preparation, GTG banding, and karyotyping using printed material and digital tools. 3. To build competence in using karyotyping software and digital imaging systems, including microphotography, image capture, and chromosome image analysis. 4. To apply dermatoglyphic techniques for clinical and genetic pattern recognition, including fingerprint analysis and palm crease evaluation for identifying syndromic associations.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Demonstrate the preparation and use of culture media and set up lymphocyte cultures for cytogenetic analysis. *(K3)*	PSO1, PSO4

	CO 2. Perform harvesting and GTG banding techniques to prepare high-quality metaphase spreads for chromosome study. *(K3)*		PSO1, PSO4	
	CO 3. Interpret human karyotypes using printed material and digital software tools, and analyze chromosomal abnormalities. (K4)		PSO5, PSO6	
	CO 4. Apply dermatoglyphic analysis techniques for recognizing genetic patterns associated with clinical syndromes. (K3)		PSO1, PSO5	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Applied Techniques in Clinical Genetics	1.1. Preparation of culture media for blood cell culture	**2**	CO1	K3
	1.2. Inoculation of lymphocyte/peripheral blood culture	**2**	CO1	K3
	1.3. Incubation monitoring and maintenance of lymphocyte culture	**2**	CO1	K3
	1.4. Harvesting of lymphocyte cultures for metaphase plate preparation	**2**	CO2	K3
	1.5. GTG banding technique: hypotonic treatment and fixation	**2**	CO2	K3
	1.6. Slide preparation and metaphase spread visualization under microscope	**2**	CO2	K3
	1.7. Chromosome identification and band pattern recognition (manual method)	**2**	CO3	K4
	1.8. Karyotyping of human chromosomes from printed specimens	**2**	CO3	K4
	1.9. Demonstration of freely available karyotyping software tools	**2**	CO3	K4
	1.10. Microphotography and image capturing of metaphase plates	**2**	CO3	K4
	1.11. Image enhancement and chromosome editing using software	**2**	CO3	K4
	1.12. Chromosomal abnormality identification using karyotype images	**2**	CO3	K4
	1.13. Introduction to dermatoglyphics and fingerprint collection	**2**	CO4	K3
	1.14. Analysis of palm and fingerprint patterns: loops, whorls, arches	**2**	CO4	K3
	1.15. Clinical interpretation of dermatoglyphic patterns in genetic disorders (case-based	**2**	CO4	K3

	exercise)			
Pedagogy:	Hands-on practical training/ Problem-based learning activities/ Viva-voce			
Texts:	1. Borgaonkar, D. S. (1990). *Chromosomal Variation in Man: A Catalog of Chromosomal Variants and Anomalies*. Wiley-Liss. 2. Cummins, H., & Midlo, C. (1961). *Fingerprints, Palms and Soles: An Introduction to Dermatoglyphics*. Dover Publications. 3. Gersen, S. L., & Keagle, M. B. (2013). *The Principles of Clinical Cytogenetics* (3rd ed.). Springer. 4. Hook, E. B., & Porter, I. H. (1977). *Population Cytogenetics: Studies in Humans*. Academic Press. 5. Rooney, D. E., & Czepulkowski, B. H. (2001). *Human Cytogenetics: Constitutional Analysis* (3rd ed.). Oxford University Press. 6. Sumner, A. T. (2003). *Chromosomes: Organization and Function*. Blackwell Publishing.			
References/ Readings:	1. Hochstenbach, R., Liehr, T. & Hastings, R.J. Chromosomes in the genomic age. (2021)Preserving cytogenomic competence of diagnostic genome laboratories. *Eur J Hum Genet* **29**, 541–552. 2. Stevens-Kroef, M., Simons, A., Rack, K., Hastings, R.J. (2017). Cytogenetic Nomenclature and Reporting. In: Wan, T. (eds) Cancer Cytogenetics. Methods in Molecular Biology, vol 1541. Humana Press, New York, NY.			
Web Resources:	1. Pollen, A.A., Kilik, U., Lowe, C.B. *et al.* Human-specific genetics: new tools to explore the molecular and cellular basis of human evolution. *Nat Rev Genet* **24**, 687–711 (2023). https://doi.org/10.1038/s41576-022-00568-4 2. Zschocke, J., Byers, P.H. & Wilkie, A.O.M. Mendelian inheritance revisited: dominance and recessiveness in medical genetics. *Nat Rev Genet* **24**, 442–463 (2023). https://doi.org/10.1038/s41576-023-00574-0			

Title of the Course	Clinical Biochemistry-II
Course Code	MLT-5010
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-5002 Clinical Biochemistry-I	
Course Objectives:	1. To develop a comprehensive understanding of the digestion, absorption, and metabolic pathways of carbohydrates, lipids, and proteins, and their clinical relevance in metabolic disorders such as diabetes, atherosclerosis, and inborn errors of metabolism. 2. To introduce the physiological and biochemical basis of electrolyte and water balance, and the mechanisms involved in homeostatic regulation and related clinical conditions. 3. To provide theoretical knowledge of biochemical function tests for cardiac, gastric, hepatic, pancreatic, thyroidal, and renal systems, including interpretation of diagnostic biomarkers and lab test results. 4. To enhance clinical decision-making skills through integrated case discussions, emphasizing the biochemical rationale for function tests and their applications in patient care and disease monitoring.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Explain the digestion, absorption, and metabolism of carbohydrates, lipids, and proteins	PSO1, PSO5

	and relate them to metabolic disorders such as diabetes mellitus, atherosclerosis, and amino acidopathies. *(K2)*			
	CO 2. Analyze the biochemical mechanisms regulating water and electrolyte balance and interpret disturbances related to sodium, potassium, and chloride homeostasis. (K4)		PSO1, PSO4	
	CO 3. Interpret diagnostic parameters and markers from function tests related to cardiac, gastric, liver, pancreatic, thyroid, and renal systems. (K4)		PSO1, PSO5	
	CO 4. Correlate biochemical test outcomes with physiological and pathological conditions and apply knowledge to support clinical decisions in laboratory settings. (K3)		PSO4, PSO5, PSO6	
	CO 5. Explain the digestion, absorption, and metabolism of carbohydrates, lipids, and proteins and relate them to metabolic disorders such as diabetes mellitus, atherosclerosis, and amino acidopathies. (K2)		PSO1, PSO5	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Carbohydrate & Lipid Metabolism &	1.1: Carbohydrate metabolism: Glycolysis, TCA cycle, Gluconeogenesis, Glycogen metabolism	**5**	CO1	K2
	1.2: Blood glucose regulation: DM, hypoglycemia, ketosis	**3**	CO1	K2
	1.3: Lipid metabolism: digestion, lipoproteins, ketone bodies, atherosclerosis	**7**	CO1	K2
Module 2: Proein metabolism, Electrolyte Balance, and Organ Function Tests – I	2.1: Protein metabolism: digestion, urea cycle, metabolic disorders (PKU, MSUD, etc.)	**6**	CO1	K2
	2.2: Electrolyte and water balance: Na^+, K^+, Cl^- regulation and imbalance	**3**	CO2	K4
	2.3: Cardiac function tests: Cardiac enzymes, markers, CVD risk profiling	**2**	CO3	K4
	2.4: Gastric function tests: HCl secretion, gastric juice analysis	**2**	CO3	K3
	2.5: Thyroid function tests: TSH, T3, T4 levels, TRH stimulation, clinical interpretations	**2**	CO3	K3
Module 3: Organ Function Tests – II	3.1: Clinical interpretation and case examples	**6**	CO4	K3
	3.2: Liver function tests: bilirubin, transaminases, protein synthesis, detoxification	**4**	CO3	K4

	3.3: Pancreatic function tests: secretions, enzyme tests	**1**	CO3	K3
	3.4: Renal function tests: clearance tests, urea/creatinine, tubular functions	**4**	CO3, CO4	K3/K 4
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Lieberman, M. A., & Ricer, R. (2019). *BRS Biochemistry, Molecular Biology, and Genetics* (8th ed.). Wolters Kluwer. 2. McPherson, R. A., & Pincus, M. R. (2017). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (24th ed.). Elsevier. 3. Murry, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2023). *Harper's Illustrated Biochemistry* (32nd ed.). McGraw-Hill Education. 4. Naik, P. (2019). *Medical Biochemistry*. (6th ed.). Jaypee Brothers Medical Publishers. 5. Satyanarayana, U., & Chakrapani, U. (2017). *Essentials of Biochemistry* (6th ed.). Elsevier Health Sciences. 6. Sood, R. (2015). *Medical Laboratory Technology* (Vol. 2). Jaypee Brothers Medical Publishers. 7. Vasudevan, D. M., & Sreekumari, S. (2013). *Practical Clinical Biochemistry*.(4th ed.). Jaypee Brothers Medical Publishers. 8. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2016). *Textbook of Biochemistry for Medical Students* (10th ed.). Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Panini, R. S. (2013). Medical biochemistry: An illustrated review. Thieme Medical Publishers. 2. Dashty M. (2013). A quick look at biochemistry: carbohydrate metabolism. Clinical biochemistry, 46(15), 1339–1352. 3. Shafi, S., Khan, H., Bajpai, P. (2024). Protein Metabolism and Its Profiling for the Diagnosis of Metabolic Disorders. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 4. Singh, P.K. et al. (2024). Enzymes and Their Clinical Applications. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 5. Niharika, Garg, M. (2024). Techniques for the Identification and Characterization of Biomolecules. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore.			
Web Resources:	1. Lippi, G., von Meyer, A., Cadamuro, J., & Simundic, A. M. (2019). Blood sample quality. *Diagnosis (Berlin,*			

	Germany), *6*(1), 25–31. https://doi.org/10.1515/dx-2018-0018 2. Kumar, J. B., Goud, B. K. M., & Kumar, A. (2021). Liver function tests: Biochemical overview for clinical correlation. *Indian Journal of Medical Biochemistry*, *25*(1), 31–37. https://doi.org/10.5005/jp-journals-10054- 0171 3. INFLIBNET Centre. (n.d.). *Biochemistry – e-Adhyayan eBooks*. https://ebooks.inflibnet.ac.in/eadhyayan/site/genre?id=Biochemistry

Title of the Course	Laboratory Course on Clinical Biochemistry-II
Course Code	MLT-5011
Number of Credits	1
Theory/Practical	Practical
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-503 Laboratory Course on Clinical Biochemistry-I	
Course Objectives:	1. To develop practical proficiency in performing biochemical estimations of routine blood and urine parameters using standard laboratory techniques. 2. To enable students to interpret clinical biochemical test results for key analytes such as bilirubin, urea, creatinine, glucose, and serum proteins. 3. To provide demonstration-based learning in advanced function tests, including renal, liver, thyroid, cardiac, and CSF analyses relevant to systemic diagnostic evaluation. 4. To familiarize students with internal quality control protocols and documentation standards critical for reliable biochemical analysis and clinical correlation.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Perform biochemical estimations of key blood parameters including glucose, bilirubin, urea, creatinine, and serum proteins using clinical chemistry methods. *(K3)*	PSO1, PSO4

	CO 2. Conduct urinalysis and interpret findings in relation to renal physiology and pathology. (K4)		PSO1, PSO5	
	CO 3. Observe and interpret function test demonstrations for liver, kidney, thyroid, and cardiac systems. (K4)		PSO1, PSO5	
	CO 4. Understand and apply quality control measures in clinical biochemistry for ensuring reliability and accuracy of test results. (K2)		PSO4, PSO6	
Content:	**Topics**	**No. of Hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Clinical Biochemistry Laboratory Practices	1.1. Chemistry of gastric juice	**2**	CO1	K3
	1.2. Demonstration: Quality Control principles and charts	**2**	CO4	K2
	1.3. Estimation of bilirubin in serum	**2**	CO1	K3
	1.4. Estimation of glucose in blood	**2**	CO1	K3
	1.5. Demonstration: GTT	**2**	CO1	K3
	1.6. Estimation of blood urea	**2**	CO1	K3
	1.7. Estimation of creatinine in blood	**2**	CO1	K3
	1.8. Estimation of uric acid in blood	**2**	CO1	K3
	1.9. Normal urine	**2**	CO2	K4
	1.10. Full urine report – chemical and microscopic examination	**2**	CO2	K4
	1.11. Demonstration: Kidney function tests, Thyroid function tests	**2**	CO3	K4
	1.12. Demonstration: Liver function tests, Cardiac function tests	**2**	CO3	K4
	1.13. Demonstration: Lipid profile (total cholesterol, HDL, LDL, triglycerides)	**2**	CO3	K4
	1.14. Demonstration: CSF examination and interpretation	**2**	CO3	K4
	1.15. Revision and integration of biochemical testing and interpretation	**2**	CO1, CO3	K3/K4

Pedagogy:	Hands-on practical training/ Problem-based learning activities/ Viva-voce
Texts:	1. Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2017). *Clinical Chemistry: Principles, Techniques, and Correlations* (9th ed.). Wolters Kluwer. 2. Mukherjee, K. L. (2010). (4th ed.)*Medical Laboratory Technology* (Vol. II). Tata McGraw-Hill Education. 3. Naik, P. (2019). Medical Biochemistry. (6th ed.). Jaypee Brothers Medical Publishers. 4. Satyanarayana, U., & Chakrapani, U. (2017). Essentials of Biochemistry (6th ed.). Elsevier. 5. Sood, R. (2009). *Medical Laboratory Technology* (Vol. I). (6th ed.) Jaypee Brothers Medical Publishers. 6. Tietz, N. W., & Burtis, C. A. (2018). *Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics* (9th ed.). Elsevier. 7. Van Rossum, H. H. (2019). *Moving average quality control: Principles, practical application and future perspectives. Clinical Chemistry and Laboratory Medicine, 57*(7), 773–782. 8. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2016). Textbook of Biochemistry for Medical Students (10th ed.). Jaypee Brothers Medical Publishers.
References/ Readings:	1. Dashty M. (2013). A quick look at biochemistry: carbohydrate metabolism. *Clinical biochemistry*, *46*(15), 1339–1352. 2. Niharika, Garg, M. (2024). Techniques for the Identification and Characterization of Biomolecules. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 3. Panini, R. S. (2013). *Medical biochemistry: An illustrated review*. Thieme Medical Publishers. 4. Shafi, S., Khan, H., Bajpai, P. (2024). Protein Metabolism and Its Profiling for the Diagnosis of Metabolic Disorders. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore. 5. Singh, P.K. *et al.* (2024). Enzymes and Their Clinical Applications. In: Singh, R.L., Singh, P., Pathak, N. (eds) Clinical Applications of Biomolecules in Disease Diagnosis. Springer, Singapore.
Web Resources:	1. INFLIBNET Centre. (n.d.). *Biochemistry – e-Adhyayan eBooks*. https://ebooks.inflibnet.ac.in/eadhyayan/site/genre?id=Biochemistry 1. Kumar, J. B., Goud, B. K. M., & Kumar, A. (2021). Liver function tests: Biochemical overview for clinical correlation. *Indian Journal of Medical Biochemistry*, *25*(1), 31–37. https://doi.org/10.5005/jp-journals-10054- 0171 2. Lippi, G., von Meyer, A., Cadamuro, J., & Simundic, A. M. (2019). Blood sample quality. *Diagnosis (Berlin, Germany)*, *6*(1), 25–31. https://doi.org/10.1515/dx-2018-0018

Title of the Course	Clinical Parasitology, Mycology and Virology
Course Code	MLT-5012
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-5004: Clinical Microbiology (General & Systematic)	
Course Objectives:	1. To introduce students to medically important parasites, fungi, and viruses, focusing on their morphology, life cycles, pathogenic mechanisms, and epidemiological significance. 2. To develop the ability to identify key diagnostic characteristics of protozoan, helminthic, fungal, and viral infections using standard laboratory techniques and clinical correlation. 3. To explore the classification, cultivation, and laboratory diagnosis of systemic viral infections, including emerging viruses with public health significance such as HIV, Hepatitis, and Arboviruses. 4. To build a foundation for accurate reporting and interpretation of parasitological, mycological, and virological test results in clinical diagnostic settings, with an emphasis on integrated disease management.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Describe the morphology, life cycle, pathogenicity, and laboratory diagnosis of medically important protozoa, cestodes, and helminths. *(K2)*	PSO1, PSO5

	CO 2. Explain the classification of fungi and diagnose common superficial, subcutaneous, and systemic mycoses using standard microbiological methods. (K2)		PSO1, PSO4	
	CO 3. Analyze virological structures, replication mechanisms, and clinical presentations of key viral pathogens, including their diagnostic strategies. (K4)		PSO1, PSO5	
	CO 4. Apply knowledge of parasitological, mycological, and virological testing in the interpretation of laboratory findings and in the diagnosis of infectious diseases. (K3)		PSO4, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Parasitology	1.1: Introduction to parasitology – definitions, terminologies, host-parasite relationships	**1**	CO1	K2
	1.2: Protozoan parasites – morphology, life cycle, diagnosis (Entamoeba, Giardia, Trichomonas, Leishmania)	**5**	CO1	K2
	1.3: Plasmodium & Cocoidian parasites – clinical diagnosis and life cycle relevance	**2**	CO1	K2
	1.4: Cestodes – Taenia saginata, Taenia solium, Echinococcus granulosus	**2**	CO1	K2
	1.5: Helminths – Trichuris, Ascaris, Ankylostoma, Enterobius, Wuchereria	**5**	CO1	K2
Module 2: Mycology	2.1: Introduction to medical mycology – classification, lab diagnosis	**2**	CO2	K2
	2.2: Candida species and dermatophytes	**3**	CO2	K2
	2.3: Cryptococcus and opportunistic fungi (Aspergillus, Penicillium, Mucor)	**4**	CO2	K2
	2.4: Subcutaneous mycoses – Mycetoma, Sporotrichosis, Rhinosporidiosis	**3**	CO2	K2
	2.5: Histoplasmosis, fungal toxins, and clinical implications	**3**	CO2	K2
Module 3: Virology	3.1: General virology – virus classification, structure, replication, cultivation, and diagnosis	**4**	CO3	K4
	3.2: Bacteriophage, Poliovirus, Rabies virus	**3**	CO3	K4
	3.3: Arboviruses – Dengue, Chikungunya, JE	**2**	CO3	K4
	3.4: Influenza, Hepatitis viruses, Herpes group	**3**	CO3	K4

	3.5: HIV – structure, replication, diagnosis, and public health implications	**3**	CO4	K3
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Baron, E. J., & Finegold, S. M. (Eds.). (1990). Bailey & Scott's Diagnostic Microbiology (8th ed.). Mosby. 2. Baveja, C. P., & Baveja, V. (2021). *Complete Microbiology*. Avichal Publishing Company. 3. Detrick, B., Hamilton, R. G., & Folds, J. D. (Eds.). (2006). Manual of Molecular and Clinical Laboratory Immunology (7th ed.). ASM Press. 4. Garcia, L. S. (2007). Diagnostic Medical Parasitology (5th ed.). ASM Press. 5. Kanungo, R., & Saxena, S. (Eds.). (2022). *Ananthanarayan and Paniker's Textbook of Microbiology* (11th ed.). Universities Press (India). 6. Murray, P. R., Baron, E. J., Pfaller, M. A., Tenover, F. C., & Yolken, R. H. (Eds.). (2003). Manual of Clinical Microbiology (8th ed.). ASM Press. 7. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2012). Medical Microbiology (7th ed.). Elsevier Saunders. 8. Sastry, A. S., & Bhat, S. (2019). *Essentials of Medical Microbiology* (2nd ed.). Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Ferrusca Bernal, D., Mosqueda, J., Pérez-Sánchez, G., Chávez, J. A. C., Neri Martínez, M., Rodríguez, A., & Carvajal-Gamez, B. (2024). Loop-Mediated Isothermal Amplification Coupled with Reverse Line Blot Hybridization for the Detection of *Pseudomonas aeruginosa*. *Microorganisms*, *12*(11), 2316. 2. Gieroń, M., Żarnowiec, P., Zegadło, K., Gmiter, D., Czerwonka, G., Kaca, W., & Kręcisz, B. (2023). Loop- Mediated Isothermal Amplification of DNA (LAMP) as an Alternative Method for Determining Bacteria in Wound Infections. *International journal of molecular sciences*, *25*(1), 411. 3. Guo, L., Ye, L., Zhao, Q., Ma, Y., Yang, J., & Luo, Y. (2014). Comparative study of MALDI-TOF MS and VITEK 2 in bacteria identification. *Journal of thoracic disease*, *6*(5), 534–538 4. Habets, M. N., van Selm, S., van der Gaast-de Jongh, C. E., Diavatopoulos, D. A., & de Jonge, M. I. (2017). A novel flow cytometry-based assay for the quantification of antibody-dependent pneumococcal agglutination. *PloS one*, *12*(3), e0170884.			
Web Resources:	NCBI Bookshelf. (n.d.). *Medical Microbiology (Baron et al.) – 4th ed.* https://www.ncbi.nlm.nih.gov/books/NBK7627/			

Title of the Course	Laboratory course on Clinical Parasitology, Mycology & Virology
Course Code	MLT-5013
Number of Credits	1
Theory/Practical	Practical
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-5005: Laboratory Course on Clinical Microbiology	
Course Objectives:	1. To train students in the gross and microscopic identification of medically important parasites, including protozoa, helminths, and cestodes, using stool and wet mount examinations. 2. To develop practical proficiency in diagnostic mycology, including culture techniques, morphological identification, and differential diagnosis of fungal infections. 3. To introduce basic virology lab techniques, including virus cultivation, antigen/antibody detection, and interpretation of diagnostic tools for common human viruses. 4. To enhance the ability to correlate laboratory findings with clinical presentations, enabling interpretation of parasitic, fungal, and viral infections in a diagnostic setting.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Identify morphological characteristics of protozoan and helminthic parasites through gross and microscopic examination of clinical specimens. *(K3)*	PSO1, PSO4

	CO 2. Perform basic diagnostic procedures for common fungal infections including wet mount, slide culture, and fungal staining techniques. (K3)		PSO1, PSO4	
	CO 3. Interpret clinical laboratory procedures for the diagnosis of viral infections, including virus structure models, serological techniques, and virus cultivation. (K4)		PSO1, PSO5	
	CO 4. Correlate microscopic findings and laboratory tests with clinical presentations of parasitic, fungal, and viral diseases. (K4)		PSO1, PSO4, PSO6	
Content:	**Topics**	**No. of Hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Clinical Microbiology Laboratory Practices	1.1. Stool examination: gross and microscopic analysis of adult parasites, ova, cysts, and larvae	**2**	CO1	K3
	1.2. Identification of intestinal/vaginal protozoa: gross and microscopic features	**2**	CO1	K3
	1.3. Laboratory diagnosis of malaria: visualization of parasite, antigen, and serology	**2**	CO1	K3
	1.4. Identification of cestodes: adult worms, segments, eggs, and larvae	**2**	CO1	K3
	1.5. Identification of helminths: morphology of adult worms, ova, and larval stages	**2**	CO1	K3
	1.6. Fungal wet mount & slide culture: Candida, Cryptococcus, Dermatophytes	**2**	CO2	K3
	1.7. Opportunistic fungi identification: Aspergillus, Mucor, Penicillium	**2**	CO2	K3
	1.8. General virology: symmetry types, virus model morphology, cultivation in embryonated egg	**2**	CO3	K4
	1.9. Laboratory diagnosis of Poliovirus, Rhabdovirus (rabies), and Influenza virus	**2**	CO3	K4
	1.10. Laboratory diagnosis of Hepatitis and HIV: antigen and antibody-based methods	**2**	CO3	K4
	1.11. Laboratory diagnosis of Herpes and Arboviruses (Dengue, JE, Chikungunya)	**2**	CO3	K4
	1.12. Interpretation of viral serology and reporting	**2**	CO4	K4
	1.13. Integration of parasitic and fungal diagnostic findings with clinical cases	**2**	CO4	K4
	1.14. Interpretation of mixed infections (case-based scenarios with protozoa, fungi, and	**2**	CO4	K4

	viruses)			
	1.15. Bacteriophage structure demonstration using models	**2**	CO3	K3
Pedagogy:	Hands-on practical training/ Problem-based learning activities/ Viva-voce			
Texts:	1. Baron, E. J., & Finegold, S. M. (1990). *Bailey & Scott's Diagnostic Microbiology* (8th ed.). Mosby. 2. Baveja, C. P., & Baveja, V. (2021). *Complete Microbiology*. Avichal Publishing Company. 3. Baveja, C. P., & Baveja, V. (2021). *Complete Microbiology*. Avichal Publishing Company. 4. Elsevier.Detrick, B., Hamilton, R. G., & Folds, J. D. (Eds.). (2006). *Manual of Molecular and Clinical Laboratory Immunology* (7th ed.). ASM Press. 5. Forbes, B. A., Sahm, D. F., & Weissfeld, A. S. (2007). *Bailey & Scott's Diagnostic Microbiology* (12th ed.). Mosby Elsevier. 6. Garcia, L. S. (2007). *Diagnostic Medical Parasitology* (5th ed.). ASM Press. 7. Greenwood, D., Slack, R., & Peutherer, J. (2012). *Medical Microbiology: A Guide to Microbial Infections* (18th ed.). 8. Kanungo, R., & Saxena, S. (Eds.). (2022). *Ananthanarayan and Paniker's Textbook of Microbiology* (11th ed.). Universities Press (India). 9. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2012). *Medical Microbiology* (7th ed.). Elsevier Saunders. 10. Sastry, A. S., & Bhat, S. (2019). *Essentials of Medical Microbiology* (2nd ed.). Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Jhaveri TA, Weiss ZF, Winkler ML, Pyden AD, Basu SS, Pecora ND. A decade of clinical microbiology: top 10 advances in 10 years: what every infection preventionist and antimicrobial steward should know. Antimicrobial Stewardship & Healthcare Epidemiology. 2024;4(1):e8. 2. Ramana, K. V. (2014). Molecular Diagnostic Methods and Their Application to Patient Care: Clinical Microbiologist's Perspective. American Journal of Clinical Medicine Research, 2(1), 8-13.			
Web Resources:	1. Microbiology Society. (n.d.). Education and outreach resources. Retrieved June 7, 2025, from https://microbiologysociety.org/resources/education-and-outreach-resources.html 2. WHO Laboratory Manual. (n.d.). Manual for the Laboratory Diagnosis of Bacterial Pathogens. https://apps.who.int/iris/handle/10665/68357			

Title of the Course	Hematology and Transfusion Medicine
Course Code	MLT-5014
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	MLT 5006: Clinical Pathology & Histology	
Course Objectives:	1. To provide an in-depth understanding of the composition and function of blood, including hematopoiesis, hemoglobin physiology, red and white blood cells, and platelet biology. 2. To enable students to interpret hematological and biochemical laboratory findings for common and critical disorders such as anemia, leukemias, hemolytic disorders, hemorrhagic conditions, and jaundice. 3. To introduce key techniques in hematological diagnostics, including peripheral smear, bone marrow studies, special stains, and flow cytometry, with emphasis on applied clinical pathology. 4. To develop competencies in the principles and practices of transfusion medicine, including blood grouping, compatibility testing, donor selection, blood component therapy, and medico-legal aspects of transfusion services.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Describe the structure, synthesis, and function of blood components including red cells, white	PSO1, PSO5

	cells, platelets, and hemoglobin, and explain their alterations in hematological disorders. *(K2)*			
	CO 2. Analyze hematological findings for diagnosing anemia, leukemias, hemolytic disorders, and hemorrhagic conditions using peripheral smears, blood indices, and specialized tests. (K4)		PSO1, PSO4, PSO5	
	CO 3. Apply principles of special staining, flow cytometry, and bone marrow diagnostics in the evaluation of blood-related diseases. (K3)		PSO1, PSO4	
	CO 4. Demonstrate understanding of transfusion medicine practices including blood grouping, compatibility testing, blood component preparation, transfusion safety, and medico-legal responsibilities. (K3)		PSO4, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Hematology – Blood Composition and Hemolytic Disorders	1.1: Composition of blood, hematopoiesis, and RBC morphology	**2**	CO1	K2
	1.2: Hemoglobin structure, function, variants, and related abnormalities	**2**	CO1	K2
	1.3: Reticulocyte count, blood indices, and peripheral smear interpretation	**3**	CO2	K4
	1.4: Hemolytic anemia: sickling, osmotic fragility, Heinz bodies, Hb electrophoresis	**3**	CO2	K4
	1.5: Lab diagnosis of anemia, meningitis, hemorrhagic disorders, jaundice	**5**	CO2	K4
Module 2: WBCs and Platelets	2.1: WBC morphology, leukocytosis, leukopenia, leukemia, differential and absolute counts	**4**	CO1, CO2	K2/K4
	2.2: Bone marrow staining, special stains in leukemia	**3**	CO3	K3
	2.3: Platelet biology, bleeding disorders, coagulation process and diagnostic investigations	**4**	CO2	K4
	2.4: Flow cytometry – principles and clinical applications	**4**	CO3	K3
	2.1: WBC morphology, leukocytosis, leukopenia, leukemia, differential and absolute counts	**4**	CO1, CO2	K2/K4
Module 3: Transfusion	3.1: ABO and Rh blood group systems, antigen-antibody reactions	**3**	CO4	K3
	3.2: Compatibility testing, Coombs test, donor selection, transfusion procedures	**4**	CO4	K3

Medicine	3.3: Transfusion reactions and complications, component therapy	**3**	CO4	K3
	3.4: Equipment used in blood banks: refrigerated centrifuge, plasma expresser, laminar air flow, etc.	**3**	CO4	K2
	3.5: Laboratory accreditation and medico-legal responsibilities	**2**	CO4	K2
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes.			
Texts:	1. Bain, B. J. (2015). *Blood Cells: A Practical Guide* (5th ed.). Wiley-Blackwell. 2. Bharadwaj, K. (2005). *Transfusion Update*. Indian Society of Blood Transfusion and Immunohaematology. Jaypee Medical Publishers. 3. Dutta, A. B. (2006). *Blood Banking and Transfusion*. CBS Publishers. 4. Hoffbrand, A. V., & Moss, P. A. H. (2016). *Essential Haematology* (7th ed.). Wiley-Blackwell. 5. Kamat, G. (2011). *Practical Manual of Hematology*. Jaypee Brothers Medical Publishers. 6. McPherson, R. A., & Pincus, M. R. (2017). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (24th ed.). Elsevier. 7. Mukherjee, K. L. (2007). *Medical Laboratory Technology* (Vol. II). Tata McGraw-Hill Publishing. 8. Rao, G. H., Eastlund, T., & Jagannath, L. (2006). *Handbook of Blood Banking & Transfusion Medicine*. Jaypee Medical Publishers. 9. Rudmann, S. V. (2005). *Textbook of Blood Banking and Transfusion Medicine* (2nd ed.). Elsevier Saunders.			
References/ Readingsk:	1. McPherson, R. A., & Pincus, M. R. (2017). *Henry's clinical diagnosis and management by laboratory methods* (23rd ed.). Elsevier. 2. Jamal, I. (2020). Cytochemical stains in haematology. *Journal of Evidence Based Medicine and Healthcare*, 7(25), 1215–1219.			
Web Resources:	Brown, M., & Wittwer, C. (2000). Flow cytometry: Principles and clinical applications in hematology. *Clinical Chemistry*, 46(8), 1221–1229.			

Title of the Course	Laboratory Course on Hematology and Transfusion Medicine
Course Code	MLT-5015
Number of Credits	1
Theory/Practical	Practical
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Course on MLT-507 Laboratory Course on Clinical Microbiology	
Course Objectives:	1. To train students in hematological techniques including hemoglobin estimation, blood cell counting, ESR, PCV, and blood indices using manual and automated methods. 2. To build skills in morphological analysis of peripheral blood and bone marrow, emphasizing smear preparation, staining, and interpretation of normal and abnormal cells. 3. To familiarize learners with essential transfusion testing procedures such as ABO and Rh grouping, Coombs testing, and compatibility assessments required in clinical blood banking. 4. To introduce specialized hematological investigations including osmotic fragility, sickling, reticulocyte count, G- 6-PD estimation, and hemoglobin electrophoresis for diagnostic decision-making.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Perform complete blood count procedures using manual and automated techniques, and interpret hematological parameters such as RBC, WBC, PCV, ESR, and blood indices. *(K3)*	PSO1, PSO4

	CO 2. Prepare and examine peripheral and bone marrow smears for morphological abnormalities and apply special stains for diagnostic evaluation. (K4)		PSO1, PSO5	
	CO 3. Execute hemolytic work-up techniques such as osmotic fragility, G-6- PD screening, sickling tests, and hemoglobin electrophoresis. (K3)		PSO1, PSO4, PSO5	
	CO 4. Conduct transfusion-related laboratory tests including ABO and Rh typing, Coombs test, and compatibility testing following safe blood bank protocols. (K3)		PSO4, PSO5	
Content:	**Topics**	**No. of Hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Laboratory Practices Hematology and Transfusion Medicine	1.1. Use and care of microscopes; study of improved Neubauer chamber	**2**	CO1	K3
	1.2. Anticoagulants and blood collection techniques	**2**	CO1	K3
	1.3. Hemoglobinometry: Sahli's and Cyanmethemoglobin methods (colorimeter/spectro)	**2**	CO1	K3
	1.4. Use and principle of Coagulometer	**2**	CO1	K3
	1.5. Hemoglobin electrophoresis and HPLC demonstration	**2**	CO3	K3
	1.6. Hematology analyzers: 3-part and 5-part counters (semi & fully automated)	**2**	CO1	K3
	1.7. Hemocytometry: RBC count using RBC pipette	**2**	CO1	K3
	1.8. Hemocytometry: Total WBC count using WBC pipette	**2**	CO1	K3
	1.9. Blood smear prep, staining, and differential WBC count	**2**	CO2	K4
	1.10. Peripheral smear examination and morphology of abnormal cells	**2**	CO2	K4
	1.11. Hemolytic work-up: osmotic fragility, Heinz bodies, sickling, G-6-PD, Hb-F estimation	**2**	CO3	K3
	1.12. Reticulocyte count and absolute eosinophil count	**2**	CO3	K3
	1.13. ESR, PCV, and blood indices (combined practical)	**2**	CO1	K3
	1.14. Platelet count, Bleeding Time (BT), Clotting Time (CT), and Capillary Refill Time (CRT)	**2**	CO1	K3

	1.15. Prothrombin Time (PT), APTT, FDP estimation	**2**	CO3	K3
Pedagogy:	Hands-on practical training/ Problem-based learning activities/ Viva-voce.			
Texts:	1. Bharadwaj, K. (2005). *Transfusion Update*. Indian Society of Blood Transfusion and Immunohaematology, Jaypee Medical. 2. Dutta, A. B. (2006). *Blood Banking and Transfusion*. CBS Publishers. 3. Kamat, G. (2011). *Practical Manual of Hematology*. Jaypee Brothers Medical Publishers. 4. McKenzie, S. B., & Williams, J. L. (2014). *Clinical Laboratory Hematology* (3rd ed.). Pearson. 5. Mukherjee, K. L. (2007). *Medical Laboratory Technology (Vol. II)*. Tata McGraw-Hill Publishing Company. 6. Rao, G. H., Eastlund, T., & Jagannath, L. (2006). *Handbook of Blood Banking & Transfusion Medicine*. Jaypee Medical Publishers. 7. Rudmann, S. V. (2005). *Textbook of Blood Banking and Transfusion Medicine* (2nd ed.). Elsevier Saunders. 8. Sood, R. (2009). *Medical Laboratory Technology*. Jaypee Brothers Medical Publishers.			
References/ Readings:	1. Jamal, I. (2020). Cytochemical stains in haematology. *Journal of Evidence Based Medicine and Healthcare*, 7(25), 1215–1219. 2. McPherson, R. A., & Pincus, M. R. (2017). *Henry's clinical diagnosis and management by laboratory methods* (23rd ed.). Elsevier.			
Web Resources:	1. Brown, M., & Wittwer, C. (2000). Flow cytometry: Principles and clinical applications in hematology. *Clinical Chemistry*, 46(8), 1221–1229.			

Discipline Specific Elective Courses

Title of the Course	Clinical Laboratory Management and Quality Assurance
Course Code	MLT-5205
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce the principles of clinical laboratory management, including organizational structure, roles and responsibilities, budgeting, inventory control, and administrative planning in diagnostic settings. 2. To develop the ability to implement and monitor Quality Management Systems (QMS) in accordance with international accreditation standards (e.g., ISO 15189), including the development of SOPs and internal quality policies. 3. To enable students to design and evaluate Quality Assurance (QA) frameworks and Quality Control (QC) protocols, using analytical tools such as control charts, calibration techniques, and performance monitoring methods. 4. To equip learners with the skills to manage laboratory errors ethically and systematically, using root cause analysis tools, CAPA frameworks, and continuous improvement cycles like PDCA and Six Sigma.	
Course Outcomes:		**Mapped to PSO**

	CO 1. Describe the organizational structure, roles, and administrative functions involved in clinical laboratory management. *(K2)*		PSO6	
	CO 2. Apply principles of budgeting, procurement, inventory control, and supplier management in laboratory operations. (K3)		PSO2, PSO6	
	CO 3. Evaluate quality management systems (QMS), accreditation frameworks (e.g., ISO 15189), and SOP development for ensuring laboratory compliance. (K5)		PSO4, PSO6	
	CO 4. Analyze and implement quality assurance and control protocols using tools like control charts, calibration procedures, and root cause analysis for error prevention. (K4)		PSO4, PSO5, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Clinical Laboratory Management	1.1: Introduction to laboratory management: organization, roles, responsibilities	**2**	CO1	K2
	1.2: Laboratory planning and administration: strategic planning, budgeting, resource allocation	**3**	CO2	K3
	1.3: Inventory management: procurement, storage, control systems, vendor contracts	**3**	CO2	K3
	1.4: Quality Management Systems (QMS): quality policies, manuals, SOP development	**3**	CO3	K5
	1.5: Accreditation and certification standards (e.g., ISO 15189), internal audits	**4**	CO3	K5
Module 2: Quality Assurance in Clinical Laboratories	2.1: Quality assurance (QA) frameworks: PDCA, Six Sigma, Lean, continuous improvement	**3**	CO3	K5
	2.2: Regulatory requirements and compliance: CLIA, CAP, NABL	**2**	CO3	K4
	2.3: Quality control procedures: protocol design, calibration, validation, control charts	**4**	CO4	K4
	2.4: Error management: error types, root cause analysis (Fishbone), documentation	**3**	CO4	K4
	2.5: Implementation of CAPA and ethical considerations in lab practice	**3**	CO4	K4
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			

Texts:	1. Garza, D., & Becan-McBride, K. (2019). *Laboratory Management: Principles and Processes*. Elsevier. 2. McPherson, R. A., & Pincus, M. R. (2017). *Henry's Clinical Diagnosis and Management by Laboratory Methods*. Elsevier. 3. Sonntag, O., & Laposata, M. (2015). *Managing the Laboratory: 12 Principles of Quality Management*. Oxford University Press. 4. Watson, C. (2007). *Good Clinical, Laboratory and Manufacturing Practices: Techniques for the QA Professional*. Woodhead Publishing. 5. Westgard, J. O. (2017). *Basic QC Practices: Training in Statistical Quality Control for Healthcare Laboratories*. Westgard QC. 6. Westgard, J. O., & Westgard, S. A. (2016). *Quality Management in the Medical Laboratory: A Practical Guide*. AACC Press.
References/ Readings:	1. Brady, A., & Sharp, G. (2017). *Managing People in the Laboratory: 5 Principles for the Laboratory Supervisor*. American Society for Clinical Laboratory Science. 2. CLSI. (2020). *Quality Management System: A Model for Laboratory Services; Approved Guideline*. Clinical and Laboratory Standards Institute. 3. ISO. (2012). *ISO 15189: Medical Laboratories – Requirements for Quality and Competence*. International Organization for Standardization. 4. WHO. (2011). *Laboratory Quality Management System: Handbook*. World Health Organization.
Web Resources:	World Health Organization. (2020). *Laboratory biosafety manual* (4th ed.). https://www.who.int/publications/i/item/9789240011311

Title of the Course	Immunology
Course Code	MLT-5206
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce the fundamental concepts of immunology, including the structure, function, and coordination of the innate and adaptive immune systems in protecting the body from infections and disease. 2. To explain the structure and roles of immunological molecules and immune cells, emphasizing antibody-mediated responses, antigen recognition, and the immune signaling cascade. 3. To provide students with clinical insights into immune system dysfunctions, including hypersensitivities, autoimmunity, immunodeficiency, and the immunological basis of transplant rejection. 4. To familiarize learners with modern immunological techniques, serological diagnostics, blood typing, and immunotherapeutic approaches used in laboratory and clinical practice.	
Course Outcomes:		**Mapped to PSO**
	CO 1. Describe the key components and mechanisms of innate and adaptive immunity, including immune cell types, lymphoid organs, and antigen recognition pathways. *(K2)*	PSO1, PSO5

	CO 2. Explain the structure and function of antibodies, MHC molecules, and antigen-antibody interactions relevant to immune defense and diagnostic testing. (K2)		PSO1, PSO4	
	CO 3. Analyze the immunopathological basis of immune system disorders and clinical conditions such as autoimmune diseases, hypersensitivity reactions, and transplant rejection. (K4)		PSO1, PSO5	
	CO 4. Apply immunological techniques (e.g., ELISA, flow cytometry, immunoblotting) and serological diagnostics for detection of infections, autoimmune markers, and immunotherapy applications. (K3)		PSO2, PSO4, PSO5	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Basic Concepts of Immunology	1.1: Introduction to immunology: definition, history, and clinical relevance	**1**	CO1	K2
	1.2: Cells and organs of the immune system: primary and secondary lymphoid tissues	**2**	CO1	K2
	1.3: Innate immunity: barriers, phagocytes, inflammation, complement system	**3**	CO1	K2
	1.4: Adaptive immunity: antigen recognition, MHC, T and B cell activation	**3**	CO1	K2
	1.5: Antibody structure and function: immunoglobulin types, effector mechanisms	**3**	CO2	K2
	1.6: Antigen-antibody interactions and immune responses	**3**	CO2	K2
Module 2: Clinical Immunology and Laboratory Diagnostics	2.1: Immune disorders: immunodeficiencies, autoimmunity, hypersensitivities, transplantation	**3**	CO3	K4
	2.2: Immunological techniques: ELISA, immunofluorescence, flow cytometry, western blotting	**3**	CO4	K3
	2.3: Serological testing: diagnostic tests for infections and autoimmune markers	**3**	CO4	K3
	2.4: Immunohematology: blood grouping, typing, transfusion compatibility	**2**	CO4	K3
	2.5: Immunotherapy: monoclonal antibodies, CAR-T cells, cytokine therapies	**2**	CO4	K3
	2.6: Emerging trends: mRNA vaccines, immunogenetics, personalized immunology	**2**	CO3	K4
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/			

	Formative quizzes.
Texts:	1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2020). *Cellular and Molecular Immunology* (9th ed.). Elsevier. 1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular Biology of the Cell* (6th ed.). Garland Science. 2. Coico, R., & Sunshine, G. (2015). *Immunology: A Short Course* (7th ed.). Wiley-Blackwell. 3. Detrick, B., Schmitz, J. L., & Hamilton, R. G. (Eds.). (2016). *Manual of Molecular and Clinical Laboratory Immunology* (8th ed.). ASM Press. 4. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2017). *Immunobiology: The Immune System in Health and Disease* (9th ed.). Garland Science. 5. Male, D., Brostoff, J., Roth, D. B., & Roitt, I. M. (2019). *Immunology* (9th ed.). Elsevier. 6. McPherson, R. A., & Pincus, M. R. (2017). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (24th ed.). Elsevier. 7. Murphy, K., & Weaver, C. (2016). *Janeway's Immunobiology* (9th ed.). Garland Science. 8. Parham, P. (2014). *The Immune System* (4th ed.). Garland Science. 9. Zabriskie, J. B. (Ed.). (2009). *Essential Clinical Immunology*. Cambridge University Press.
References/ Readings:	1. Barrett, T., & Bennett, C. (2016). Single-cell immunology: Technology and applications. *Nature Reviews Immunology*, *16*(3), 169–182. 2. Murray, P. J. (2015). Metabolic reprogramming of macrophages and T cells in inflammation. *Journal of Clinical Investigation, 125*(2), 511–520. 3. Netea, M. G., Joosten, L. A. B., Latz, E., et al. (2016). Trained immunity: A program of innate immune memory in health and disease. *Science, 352*(6284), aaf1098. 4. Pardoll, D. M. (2012). The blockade of immune checkpoints in cancer immunotherapy. *Nature Reviews Cancer*, *12*(4), 252–264. 5. Turvey, S. E., & Broide, D. H. (2010). Innate immunity. *Journal of Allergy and Clinical Immunology, 125*(2 Suppl 2), S24–S32
Web Resources:	1. Alberts, B., Johnson, A., Lewis, J., et al. (2002). *Molecular biology of the cell* (4th ed.). Inflammation and immune system pathways. National Center for Biotechnology Information (NCBI). https://www.ncbi.nlm.nih.gov/books/NBK21070/

	2. Centers for Disease Control and Prevention (CDC). (2015). *Epidemiology and prevention of vaccine- preventable diseases* (13th ed.). Public Health Foundation. National Center for Biotechnology Information (NCBI). https://www.ncbi.nlm.nih.gov/books/NBK285557/ 3. Ewald, P. W. (2004). *Immunology and evolution of infectious disease*. Oxford University Press. https://www.ncbi.nlm.nih.gov/books/NBK2394/ 4. Gerriets, V., Anderson, J., & Nappe, T. M. (2021, July 3). *Acetaminophen*. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK532327/ 5. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2001). *Immunobiology: The immune system in health and disease* (5th ed.). Garland Science. https://www.ncbi.nlm.nih.gov/books/NBK10757/

Title of the Course	Epidemiology and Outbreak Investigation
Course Code	MLT-5207
Number of Credits	4
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To develop a conceptual and operational understanding of core epidemiological methods relevant to public health and clinical laboratory contexts. 2. To guide students in applying disease surveillance techniques and analyzing epidemiological data for outbreak detection and response. 3. To train students in the structured investigation of outbreaks using laboratory-supported tools, including case definitions, transmission dynamics, and reporting systems. 4. To encourage critical thinking on the ethical, communicative, and logistic challenges in field epidemiology and public health emergency response.	
Course Outcomes:	At the end of the course learner will be able to	**Mapped to PSO**
	CO 1. Explain key epidemiological concepts, measures, and study designs. (K2)	PSO1, PSO5
	CO 2. Interpret basic health data to identify disease trends and suspected outbreaks. (K3)	PSO1, PSO5

	CO 3. Apply stepwise protocols for outbreak investigations using clinical and laboratory evidence. (K3)		PSO2, PSO4	
	CO 4. Evaluate national and global epidemic response systems and the role of diagnostic laboratories. (K5)		PSO3, PSO6	
	CO 5. Reflect on ethical and communication strategies used during epidemics and health crises. (K5)		PSO3, PSO6	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Principles of Epidemiology	1.1. Definitions and scope of epidemiology	**2**	CO1	K2
	1.2. Measures of disease frequency	**3**	CO1	K2
	1.3. Measures of association	**2**	CO1	K2
	1.4. Descriptive epidemiology	**2**	CO1	K2
	1.5. Study designs	**3**	CO1	K2
	1.6. Bias, confounding, and causation	**3**	CO1	K2
Module 2: Surveillance Systems and Data Interpretation	2.1. Types of surveillance	**2**	CO2	K3
	2.2. Notifiable diseases and reporting systems	**2**	CO2	K3
	2.3. Data sources in epidemiology	**2**	CO2	K3
	2.4. Epidemic curves	**3**	CO2	K3
	2.5. Spot maps and spatial analysis	**2**	CO2	K3
	2.6. Use of software tools (Epi Info, Excel)	**4**	CO2	K3
Module 3: Outbreak Investigation Framework and Laboratory	3.1. Steps in outbreak investigation	**3**	CO3	K3
	3.2. Sampling strategies	**2**	CO3	K3
	3.3. Field-based sample collection and rapid testing	**3**	CO3	K3
	3.4. Lab-clinic coordination in outbreaks	**2**	CO3	K3

Interface	3.5. Cluster analysis and attack rate calculations	**2**	CO3	K3
	3.6. Case studies	**3**	CO3	K3
Module 4: Response, Communication, and Ethics in Epidemics	4.1. Components of outbreak response	**2**	CO4	K5
	4.2. National and international response systems	**2**	CO4	K5
	4.3. Risk communication and media engagement	**2**	CO5	K5
	4.4. Ethical considerations in epidemic management	**3**	CO5	K5
	4.5. Legal and policy frameworks	**3**	CO5	K5
	4.6. Reflection and post-outbreak audit	**3**	CO5	K5
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			
Texts:	1. Arias, K. M. (2010). *Outbreak investigation, prevention, and control in health care settings: Critical issues in patient safety* (2nd ed.). Jones & Bartlett Learning. 2. Celentano, D. D., & Szklo, M. (2018). *Gordis epidemiology* (6th ed.). Elsevier. 3. Centers for Disease Control and Prevention. (2015). *Epidemiology and prevention of vaccine-preventable diseases* (13th ed.; J. Hamborsky, A. Kroger, & C. Wolfe, Eds.). Public Health Foundation. 4. Detels, R., Gulliford, M., Karim, Q. A., & Tan, C. C. (Eds.). (2015). *Oxford textbook of global public health* (6th ed.). Oxford University Press 5. Oomen, B., & Gastaldi, S. (Eds.). (2025). *Principles of nursing infection prevention control: Introduction and global context of infection prevention and control (Volume 1)*. Springer. 6. Rasmussen, S. A., & Goodman, R. A. (Eds.). (2019). *The CDC field epidemiology manual*. Oxford University Press.			
References/ Readings:	1. Beer, E. M., & Rao, V. B. (2019). A systematic review of the epidemiology of human monkeypox outbreaks and implications for outbreak strategy. *PLoS neglected tropical diseases*, *13*(10), e0007791. 2. Abbas, K. M., Dorratoltaj, N., O'Dell, M. L., Bordwine, P., Kerkering, T. M., & Redican, K. J. (2016). Clinical Response, Outbreak Investigation, and Epidemiology of the Fungal Meningitis Epidemic in the United States: Systematic Review. *Disaster medicine and public health preparedness*, *10*(1), 145–151. 3. Bartlett, P. C., & Judge, L. J. (1997). The role of epidemiology in public health. *Revue scientifique et technique*			

	(International Office of Epizootics), *16*(2), 331–336. 4. Cornish, N. E., Anderson, N. L., Arambula, D. G., Arduino, M. J., Bryan, A., Burton, N. C., Chen, B., Dickson, B. A., Giri, J. G., Griffith, N. K., Pentella, M. A., Salerno, R. M., Sandhu, P., Snyder, J. W., Tormey, C. A., Wagar, E. A., Weirich, E. G., & Campbell, S. (2021). Clinical Laboratory Biosafety Gaps: Lessons Learned from Past Outbreaks Reveal a Path to a Safer Future. *Clinical microbiology reviews*, *34*(3), e0012618.
Web Resources:	1. *Indian Council of Medical Research. (n.d.). Downloadable books. Government of India. Retrieved June 7, 2025, from https://www.icmr.gov.in/downloadable-books* 2. World Health Organization. (2021). *Manual for investigating suspected outbreaks of illnesses of possible chemical etiology: Guidance for investigation and control*. WHO. *https://iris.who.int/handle/10665/342818* 3. World Health Organization. (n.d.). *Stages of an outbreak investigation*. Retrieved June 7, 2025, from *https://www.who.int/emergencies/outbreak-toolkit/investigating-outbreak-of-unknown-disease*

Title of the Course	Public Health Laboratory Practices
Course Code	MLT-5208
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide foundational understanding of public health laboratory systems and their roles in surveillance, outbreak response, and health system strengthening. 2. To train students in specimen handling, diagnostic workflows, and quality practices specific to public health laboratory settings. 3. To enable learners to navigate biosafety, accreditation, and reporting protocols essential to public health diagnostics. 4. To facilitate understanding of how public health laboratories integrate with national disease control programs and international health regulations.	
Course Outcomes:	At the end of the course learner will be able to	**Mapped to PSO**
	CO 1. Explain the structure, purpose, and functions of public health laboratory networks.(K2)	PSO1, PSO3
	CO 2. Describe specimen collection, testing, and documentation processes in the context of disease surveillance.(K2)	PSO1, PSO4

	CO 3. Apply principles of biosafety, quality assurance, and regulatory compliance in public health laboratory operations.(K3)		PSO2, PSO3	
	CO 4. Recognize the contribution of public health laboratories in managing notifiable diseases, outbreaks, and public health emergencies.(K4)		PSO3, PSO5	
	CO 5. Explain the structure, purpose, and functions of public health laboratory networks.(K2)		PSO1, PSO3	
Content:	**Topics**	**No of hours**	**Mapped to CO**	**Cognitive Level**
Module 1: Framework and Functions of Public Health Laboratories	1.1. Public Health Laboratories: Definitions, evolution, and organizational models (central, state, district)	2	CO1	K2
	1.2. Roles in disease surveillance, outbreak investigation, and health screening programs	3	CO1	K2
	1.3. Types of public health lab services: microbiology, water/food testing, vector-borne diseases, environmental health	3	CO1	K2
	1.4. Reporting systems: IDSP, notifiable disease reporting, lab- based surveillance systems	3	CO2	K2
	1.5. Case studies: COVID-19 testing labs, measles-rubella surveillance, integrated disease surveillance programs	4	CO2	K2
Module 2: Operational Standards, Biosafety, and Quality Assurance	2.1 Specimen collection and transport for surveillance: stool, sputum, water, serum, food samples	3	CO2	K2
	2.2 Sample tracking, chain-of-custody, and documentation procedures	2	CO2	K2
	2.3 Laboratory biosafety in public health labs: BSL levels, disinfection, spill control, PPE	3	CO3	K3
	2.4 Quality control and lab accreditation in public health settings (NABL, ISO, CLSI)	3	CO3	K3
	2.5 Public-private partnerships, mobile public health labs, and diagnostic networks in rural areas	2	CO4	K4
	2.6 Data analysis, interpretation, and reporting for public health decision-making	2	CO4	K4
Pedagogy:	Lectures/Seminars/ Problem-based learning activities/ Multimedia Presentations/case-based Group discussions/ Formative quizzes			

Texts:	1. Friis, R. H., & Sellers, T. A. (2020). *Epidemiology for public health practice* (6th ed.). Jones & Bartlett Learning. 2. Mathur, M., Mathur, N., & Verma, A. (2021). *Essentials of public health laboratory: A brief of research laboratory in community medicine*. LAP LAMBERT Academic Publishing.
References/ Readings:	1. Inhorn, S. L., Wilcke, B. W. Jr., & Downes, F. P. (2006). A comprehensive laboratory services survey of state public health laboratories. Journal of Public Health Management and Practice, 12(6), 512–518. 2. Keckler, M. S., Anderson, K., McAllister, S., & Rasheed, J. K. (2019). Development and implementation of evidence-based laboratory safety management tools for a public health laboratory. *Safety Science, 116,* 116– 124. 3. Lipsitch, M., & Grad, Y. (2024). Diagnostics for Public Health - Infectious Disease Surveillance and Control. *NEJM evidence*, *3*(5), EVIDra2300271. https://doi.org/10.1056/EVIDra2300271
Web Resources:	1. Astles, J. R., White, V. A., & Williams, L. O. (2010). Origins and development of the National Laboratory System for public health testing. Public Health Reports, 125(Suppl 2), 18–30. https://doi.org/10.1177/00333549101250S203 2. Huebner, R. E., Good, R. C., & Tokars, J. I. (1993). Current practices in mycobacteriology: Results of a survey of state public health laboratories. *Journal of Clinical Microbiology*, *31*(4), 771–775. https://doi.org/10.1128/jcm.31.4.771-775.1993 3. Ministry of Health and Family Welfare, Government of India. (n.d.). *Airport Health Organization (APHO), Delhi*. Integrated Health Information Platform – International Health Regulations (IHR) Points of Entry. https://ihpoe.mohfw.gov.in/apho_delhi.php 4. National Institute of Public Health Training and Research. (n.d.). *E-books*. Ministry of Health and Family Welfare, Government of India. Retrieved June 7, 2025, from https://www.niphtr.mohfw.gov.in/content/e- books 5. Olver, P., Bohn, M. K., & Adeli, K. (2023). Central role of laboratory medicine in public health and patient care. *Clinical Chemistry and Laboratory Medicine, 61*(5), 784–788. https://doi.org/10.1515/cclm-2022-1075 6. Van Caeseele, P., Bailey, D., Forgie, S. E., Dingle, T. C., & Krajden, M. (2020). SARS-CoV-2 (COVID-19) serology: Implications for clinical practice, laboratory medicine and public health. *Canadian Medical Association Journal*, *192*(34), E973–E979. https://doi.org/10.1503/cmaj.201588 7. World Health Organization. (n.d.). *Strengthening public health laboratory services*. https://www.who.int/activities/strengthening-public-health-laboratory-services