

GURU KASHI UNIVERSITY



**Masters of Science in
Medical Laboratory Technology
(Clinical Microbiology)
Session: 2024-25
Department of Paramedical Sciences**

Graduate Outcomes of the Programme:

M.Sc. MLT (Clinical Microbiology) imparts to the students an intensive knowledge in the field of Microbiology. After completion of this programme the graduates will be able to work independently in the field of Mycology, Virology, Parasitology, Immunology and Bacteriology.

Programme Learning Outcomes: After completion of this programme learner will be able to:

1. Undertake further advanced research of the highest quality that contributes to knowledge and exhibits authoritative international standing in their own specialization.
2. Make potentially innovative, and important contributions to society, culture, and the global community.
3. Conduct original and rigorous research, contributing new knowledge and insights to their field of study.
4. Formulate effective planning and time management to meet research deadlines and balance academic commitments.
5. Explore new innovations and remain updated with the latest developments in their field.
6. Think critically and creatively, exploring novel approaches to problem-solving and research questions.

Programme Structure

Semester -I							
Sr. No.	Course Code	Course Title	Type of course	L	T	P	Credits
1	MML113	General Microbiology & Immunology	Core	4	0	0	4
2	MML103	Systemic Bacteriology	Core	4	0	0	4
3	MML114	Fundamentals of Research	Research Skills	2	0	0	2
4	MML115	General Microbiology & Immunology Laboratory Lab	Skill Based	0	0	4	2
5	MML109	Systemic Bacteriology Laboratory Lab	Skill Based	0	0	4	2
6	MML116	Communication & Soft Skills	Compulsory Foundation	2	0	0	2
7	MML117	Human Rights and Duties	Multidisciplinary	3	0	0	3
Discipline Elective-I (Any one of the following)							
8	MML104	General Biochemistry	Disciplinary	3	0	0	3
9	MML105	General Hematology	Elective-I				
TOTAL				16	0	8	22

Semester -II							
Sr. No.	Course Code	Course Title	Type of course	L	T	P	Credits
1	MML201	Advanced Techniques in Bacteriology	Core	4	0	0	4
2	MML211	Mycology & Virology	Core	4	0	0	4
3	MML212	Molecular Biology and Applied Genetics	Core	4	0	0	4
4	MML213	Advanced Techniques in Bacteriology Laboratory	Skill Based	0	0	4	2
5	MML214	Mycology & Virology Laboratory	Skill Based	0	0	4	2
6	MML203	First Aid	VAC	2	0	0	2
7	MML299	XXXX	MOOC	0	0	0	2
Disciplinary Elective-II (Any one of the following)							
8	MML215	Medical Parasitology	Disciplinary Elective-II	3	0	0	3
9	MML216	Transfusion Medicine					
Disciplinary Elective-III (Any one of the following)							
10	MML219	Clinical Pathology	Disciplinary Elective-III	3	0	0	3
11	MML220	Environmental Toxicology					
TOTAL				22	0	8	26

Semester -III							
Sr. No.	Course Code	Course Title	Type of course	L	T	P	Credits
1	MML312	Research Methodology	Compulsory foundation	2	0	0	2
2	MML318	Clinical Research	Research Project	0	0	4	2
3	MML319	Bioethics & Intellectual Property Right	Elective Foundation	2	0	0	2
4	MML320	Systemic Bacteriology	Core	4	0	0	4
5	MML321	Systemic Bacteriology Practical Lab	Skill Based	0	0	4	2
6	MML322	Bioinformatics and Computational biology Lab	Skill Based	0	0	2	1
7	MML399	XXXX	MOOC	0	0	0	2
8	MML323	Innovation, creativity and Entrepreneurial mind set	Entrepreneurship Skills	2	0	0	2
9	MML324	Drug Abuse	VAC	2	0	0	2
Disciplinary Elective-IV (Any one of the following)							
10	MML325	Biomedical Techniques & Laboratory Management	Disciplinary Elective-IV	3	0	0	3
11	MML326	Clinical Enzymology					
Open Elective Courses (for other Department)							
12	XXXX	XXXX	IDC	2	0	0	2
Total				17	0	8	24
Open Elective Courses (for other Department)							
13	OEC072	First Aid	Open Elective	2	0	0	2
14	OEC016	Health care and Nutrition					

Semester-IV

Sr. No.	Course Code	Course Title	Type of Course	L	T	P	Credits
1	MML401	Dissertation	Dissertation	0	0	0	20
2	MML402	Skills & Professional Development	AEC	0	0	2	1
Total				0	0	2	21

Evaluation Criteria for Theory Courses**A. Continuous Assessment: [25 Marks]**

CA1- Surprise Test (Two best out of three) (10 Marks)

CA2- Assignment(s) (10 Marks)

CA3- Term paper/ Quiz/Presentation (05 Marks)

B. Attendance (05 Marks)**C. Mid Semester Test: (30 Marks)****D. End-Semester Exam: (40 Marks)**

Semester: 1st**Course Title: General Microbiology****Course Code: MML101**

L	T	P	Cr.
4	0	0	4

Total Hours: 60**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Identify the bacterial, fungal, and parasitic species by microscopic examination.
2. Acquire the basic knowledge of lab diagnosis of pathogenic microorganisms that helps in treatment of diseases.
3. Elaborate the ideas about the introduction of infection and its types, pathogenicity and laboratory diagnosis of nosocomial infection.
4. Analyze the rule of microbial growth identification and laboratory diagnosis of bacterial infection, prevention and control of infections.

Course Contents**UNIT- I****14 Hours**

Introduction, history & scope of Microbiology: Introduction and historical developments of microbiology, scope of microbiology, general characteristics of prokaryotes and eukaryotes, classification of prokaryotes, introduction to mycology, virology and parasitology

UNIT-II**16 Hours**

Microscopy: Importance of microscopy, principle, operation and applications of light microscope, phase contrast microscopy, fluorescence microscopy, electron microscopy. Structure of Bacterial cell :General structure and functions of gram positive and gram negative bacteria, cell wall, cell membrane, cytoplasmic inclusions and mesosome, flagella, capsule, ribosome, chromosome, plasmid and endospore, morphological classification of bacteria.

UNIT-III**16 Hours**

Sterilization & disinfection: Introduction and its types, principle, procedure and its application, quality control for sterilization and disinfectant techniques, biosafety in microbiology lab. Nutrition & growth: kinetics of growth, continuous culture and synchronous growth cultures, aerobic & anaerobic cultures, Introduction and its

types, various factors effects on microbial growth. Chemotherapeutic agents: Introduction, types, mode of action and its clinical importance of antibiotic sensitivity tests, Introduction, types, mode of action and importance of multiple drugs resistance, mechanism of drug resistance.

UNIT-IV

14 Hours

Lab diagnosis of pathogenic microorganisms: Normal microbial flora of the human body, collection and transport of specimens, processing of clinical specimens for microbiological examination. Environmental and applied microbiology: Bacteriology of air, water, food, milk. Nosocomial infections: Introduction and its types, pathogenicity and laboratory diagnosis of nosocomial infection, prevention and control of nosocomial infections

Transaction Modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Brown, A., & Smith, H. (2014). Benson's Microbiological Applications, Laboratory Manual in General Microbiology, Short Version. McGraw-Hill Education.*
- *E Brown (2001). Benson's Microbiological Applications Laboratory Manual in General Microbiology-Alfred E Brown.*
- *Tortora, G. J., Funke, B. R., Case, C. L., Weber, D., & Bair, W. (2004). Microbiology: an introduction (Vol. 9). San Francisco, CA: Benjamin Cummings.*
- *Parija, S. C. (2013). Textbook of Microbiology & Immunology-E-book. Elsevier Health Sciences.*
- *Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2020). Medical microbiology E-book. Elsevier Health Sciences.*

Course Title: Immunology**Course Code: MML102**

L	T	P	Cr.
4	0	0	4

Total Hours: 60**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Express immune system, antigens, antibodies and their structure and function.
2. Illustrate the antigen - antibody binding, precipitation and agglutination reaction
3. Analyze immuno-electrophoresis and immune fluorescence, ELISA and Western blotting, their use in diagnosis.
4. Identify the factors responsible for Antigen-antibody reactions and their significance in diagnosis tools.

Course Contents**UNIT-I****14 Hours**

Immune System: Introduction and overview on innate and adaptive immunity, primary and secondary lymphoid tissues and organs, cells of immune system.

Antigens: Factors responsible for immunogenicity, immunogen, hapten and adjuvant, epitopes, heterophile antigen, super antigen. Antibodies: Structure and function of immunoglobulin, monoclonal antibodies, immunoglobulin genes, generation of antibody diversity, immunoglobulin super family

UNIT-II**16 Hours**

Antigen-antibody reactions: Molecular mechanism of antigen - antibody binding, precipitation and agglutination reaction, immuno-electrophoresis and immune fluorescence, ELISA and Western blotting. MHC: Structure of MHC molecules, MHC and peptide interaction, antigen processing and presentation, transplantation rejection, HLA complex in human.

UNIT-III**18 Hours**

Cytokines and Regulation: Common properties of cytokines and cytokine types, biological activities of cytokines, pro-inflammatory cytokines, cytokine diseases and therapies, B-cell and T-cell Activation :BCR and TCR, cell interactions in antibody response, B cell activation, synthesis and secretion of immunoglobulin's, T cell maturation, activation and differentiation, Humoral and cell-mediated effectors responses: Immune responses to infection, leukocyte recirculation and inflammation, neutralization, opsonisation and ADCC, vaccines

UNIT-IV

12 Hours

Tolerance and Autoimmunity: Mechanism of self-tolerance, hypersensitivity reactions, AIDS and other immune deficiencies, cancer and the immune system. Complement System: Introduction to complement system, classical, alternative and lectin complement pathway, biological effect of complement system, regulation of complement system

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Brown, A., & Smith, H. (2014). Benson's Microbiological Applications, Laboratory Manual in General Microbiology, Short Version. McGraw-Hill Education.*
- *Tortora, G. J., Funke, B. R., Case, C. L., Weber, D., & Bair, W. (2004). Microbiology: an introduction (Vol. 9). San Francisco, CA: Benjamin Cummings.*
- *Parija, S. C. (2013). Textbook of Microbiology & Immunology-E-book. Elsevier Health Sciences.*
- *Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2020). Medical microbiology E-book. Elsevier Health Sciences.*

Course Title: Systemic Bacteriology

Course Code: MML103

L	T	P	Cr.
4	0	0	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Illustrate morphology, biochemical reactions, to differentiate bacteria and their related diseases.
2. Differentiate between gram positive and gram negative bacteria by using staining.
3. Perform antibiotic susceptibility testing for recommendation of antibiotic for treatment.
4. Learn structural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of different types of bacteria.

UNIT-I

14 Hours

Epidemiology and control of community infections: Study of normal flora of human body, control and prevention of community, epidemiological markers, different carries and sources of infection, Gram positive cocci: A detailed account of morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Staphylococcus, Streptococcus and Pneumococcus, Gram positive bacilli: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Corynebacterium, Bacillus and Clostridium

UNIT-II

14 Hours

Acid fast bacteria and Gram negative cocci: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Mycobacterium tuberculosis and Mycobacterium leprae, Neisseria. Enterobacteriaceae-I: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Enterobacteriaceae families like E.coli and Klebsiella, Shigella and Salmonella.

Enterobacteriaceae-II: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Enterobacteriaceae like Proteus and Acinetobacter, Hafnia and Enterobacter, Serratiamarcescens and Citrobacter.

UNIT-III

18 Hours

Gram negative bacilli-I: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Pseudomonas aeruginosa and Vibrio, Haemophilus influenzae and Campylobacter jejuni, Gram negative bacilli-II: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Bordetella pertussis and Yersinia pestis, Bacteroides and Helicobacter pylori, Miscellaneous bacteria-I: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Mycoplasma and Rickettsia, Ehrlichia, Chlamydiae and Moraxella catarrhalis

UNIT-IV

14 Hours

Miscellaneous bacteria-II: A detailed account of cultural and morphological characteristics, pathogenicity, clinical manifestations and laboratory diagnosis of Actinomycetes (Actinomyces and Nocardia) and Spirochaetes (Treponema, Borrelia, Leptospira), Brucellae and Listeria monocytogenes

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Ananthanarayan, R. (2006). Ananthanarayan and Paniker's textbook of microbiology. Orient Blackswan*
- *Panjarathinam, R. (2007). Medical microbiology. New Age International.*
- *Kumar, S. (2012). Textbook of microbiology. JP Medical Ltd.*
- *Lederberg, J. (2000). Encyclopedia of microbiology, four-volume set. Academic Press.*
- *Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). Textbook of diagnostic microbiology-e-book. Elsevier Health Sciences.*
- *Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). Koneman's color atlas and textbook of diagnostic microbiology. Jones & Bartlett Publishers.*

Course Title: Immunology Laboratory

Course Code: MML108

L	T	P	Cr.
0	0	4	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Acknowledge immune system, antigens, antibodies, immunoglobulin, monoclonal antibodies, and immunoglobulin and their structure and function.
2. Recall antigen - antibody binding, precipitation and agglutination reaction.
3. Assess vaccine against AIDS, immune system, cancer and other immune deficiency diseases.
4. Analyze immuno-electrophoresis and immune fluorescence, ELISA and Western blotting, their use in diagnosis.

Course Contents

List of Practical's / Experiments:

1. To perform VDRL Tests.
2. To perform Brucella Agglutination test.
3. To perform Weil Felix test (Demonstration only).
4. To perform Paul Bunnell test (Demonstration only).
5. To perform RA test.
6. To perform CRP test.
7. To perform TPHA test.
8. To perform ELISA test.
9. To perform ASLO test.
10. To perform Widal test.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Ananthanarayan, R. (2006). Ananthanarayan and Paniker's textbook of microbiology. Orient Blackswan*
- *Panjarathinam, R. (2007). Medical microbiology. New Age International..*
- *Willey, J. M., Sherwood, L., & Woolverton, C. J. (2011). Prescott's microbiology (Vol. 7). New York: McGraw-Hill.*
- *Tortora, G. J., Funke, B. R., & Case, C. L. (2007). Microbiology: an introduction (p. 912). San Francisco, CA: Pearson Benjamin Cummings.*
- *Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). Textbook of diagnostic microbiology-e-book. Elsevier Health Sciences.*
- *Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). Koneman's color atlas and textbook of diagnostic microbiology. Jones & Bartlett Publishers.*

Course Title: Systemic Bacteriology Laboratory

Course Code: MML109

L	T	P	Cr.
0	0	4	2

Total Hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify microbes from skin/pus samples.
2. Isolate microorganism and perform identification of various bacterial strains from different samples.
3. Prepare specific media used for culture, identification and differentiation process of microorganism.
4. Collect samples from various sites of body for diagnose and culture of microorganism.

Course Contents

List of Practical's / Experiments:

1. To isolate and identify the pathogenic microorganisms from skin/pus.
2. To isolate and identify the pathogenic microorganisms from blood sample.
3. To isolate and identify the pathogenic microorganisms from Urine sample.
4. To isolate and identify the pathogenic microorganisms from throat.
5. To isolate and identify the pathogenic microorganisms from sputum sample.
6. To isolate and identify the pathogens present in air.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Ananthanarayan, R. (2006). Ananthanarayan and Paniker's textbook of microbiology. Orient Blackswan*
- *Panjarathinam, R. (2007). Medical microbiology. New Age International.*

- *Kumar, S. (2012). Textbook of microbiology. JP Medical Ltd.*
- *Willey, J. M., Sherwood, L., & Woolverton, C. J. (2011). Prescott's microbiology (Vol. 7). New York: McGraw-Hill.*
- *Tortora, G. J., Funke, B. R., & Case, C. L. (2007). Microbiology: an introduction (p. 912). San Francisco, CA: Pearson Benjamin Cummings.*
- *Lederberg, J. (2000). Encyclopedia of microbiology, four-volume set. Academic Press.*
- *Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). Textbook of diagnostic microbiology-e-book. Elsevier Health Sciences.*
- *Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). Koneman's color atlas and textbook of diagnostic microbiology. Jones & Bartlett Publishers.*

Course Title: General Biochemistry**Course Code: MML104**

L	T	P	Cr.
3	0	0	3

Total Hours 45**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Acknowledge biomolecules, metabolism and inborn errors of metabolism.
2. Recall various organ function tests and their significance in result interpretation.
3. Correlate the knowledge of patho-physiology of organ system and hormonal imbalance.
4. Apply biochemical changes involved in various clinical conditions associated with glands and organs of human body.

Course Contents**UNIT-I****12 Hours**

Chemistry and metabolism of Carbohydrates- Definition, Aerobic & Anaerobic glycolysis, sequence of reactions in glycolysis, regulation in glycolysis, citric acid cycle, glycogenesis, glycogenolysis (sequence of reactions & regulation), Pentose-phosphate pathway (sequence of reactions & regulation), and extraction of energy from food sources.

UNIT-II**11 Hours**

Chemistry and metabolism of lipids- Definition, classification, Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, ketone bodies.

UNIT-III**10 Hours**

Chemistry and metabolism of proteins- Definition -Important properties of proteins and amino acids -general metabolism of different amino acids – Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic

precursors (haem biosynthesis & degradation, biosynthesis of epinephrine, dopamine, serotonin, GABA, histamine, glutathione); biosynthesis of essential & non-essential amino acids

UNIT-IV

12 Hours

Chemistry and metabolism of nucleic acids- Definition -Importance - properties of nucleic acids, purine and pyridine metabolism.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested readings

- *Champe, P. C., Harvey, R. A., & Ferrier, D. R. (2005). Biochemistry. Lippincott Williams & Wilkins.*
- *Ferrier, D. R. (2014). Biochemistry. Lippincott Williams & Wilkins.*
- *Varley, H. (1954). Practical clinical biochemistry. Practical clinical biochemistry.*
- *Lucock, M. (2000). Folic acid: nutritional biochemistry, molecular biology, and role in disease processes. Molecular genetics and metabolism, 71(1-2), 121-138.*
- *Nelson, D. L., Lehninger, A. L., & Cox, M. M. (2008). Lehninger principles of biochemistry. Macmillan.*
- *Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2013). Textbook of biochemistry for medical students. JP Medical Ltd.*

Course Title: General Haematology**Course Code: MML105**

L	T	P	Cr.
3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Preparation of smears and staining for diagnostic purposes.
2. Analyze working, maintenance and calibration of cell counters.
3. Perform hematological testing for diagnosis, internal quality control, external quality control, standardization of instruments.
4. Prepare anticoagulants and their uses in various investigations.

Course Contents

UNIT-I**11 Hours**

Introduction to hematology: Definition, importance, important equipment and chemicals, various tests performed, laboratory organization and safety measures in hematology laboratory. Composition and function of blood: Definition of blood, composition of blood (cells, plasma /serum) Formation of blood: Erythropoiesis, Leucopoiesis, Thrombopoiesis.

UNIT-II**12 Hours**

Anticoagulants: Definition, uses, different types, mode of action, their merits and demerits Collection and Preservation of blood Sample for various hematological investigation, Definition, Principle & Procedure, Normal values, Clinical significance, Errors involved, mean to minimize errors for the following.

UNIT-III**10 Hours**

Haemoglobinometry: Haemoglobinometry definition, Total Leucocyte count (TLC), Differentiate leucocyte count (DLC), Erythrocyte Sedimentation Rate (ESR), Packed cell volume/ Hematocrit value, Red cell indices (RCL), Absolute Eosinophil count (ESR), Reticulocyte count, Platelet count, Preparation of blood films.

UNIT-IV**12 Hours**

Types methods of preparation (Thick and thin smear/film) staining technique in Hematology (Romanovsky stains): Principle, composition, preparation staining reagents and procedure for the Giemsa and Leishman stain.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Wintrobe, M. M. (1962). Clinical hematology. Academic Medicine, 37(1), 78.*
- *Bain, B. J., Bates, I., & Laffan, M. A. (2016). Dacie and lewis practical haematology e-book. Elsevier Health Sciences.*
- *Robbins, S. L. (2002). Pocket companion to Robbins pathologic basis of disease. Elsevier Health Sciences TW.*
- *Kumar, V., Abbas, A. K., & Aster, J. C. (2017). Robbins basic pathology e-book. Elsevier Health Sciences.*
- *Godkar, P. B., & Godkar, D. P. (2003). Textbook of medical laboratory technology. Bhalani.*
- *Sood, R. (2009). Concise Book of Medical Laboratory Technology: Methods and Interpretations. Jaypee Brothers Medical Publishers (P) Limited.*
- *Mukherjee, K. L. (2010). Med Lab Tech Vol 1, 2/e. Tata McGraw-Hill Education.*
- *Kolhatkar, A., Ochei, J., & McGraw, T. (2008). Medical Laboratory Science: Theory and Practice.*
- *Kawthalkar, S. M. (2012). Essentials of haematology. JP Medical Ltd.*

Course Title: Clinical Pathology**Course Code: MML111**

L	T	P	Cr.
3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Identify and differentiate various pathological conditions based on laboratory findings
- 2 Interpret and analyze laboratory results, including hematological, biochemical, and immunological tests.
- 3 Understand the principles and techniques of clinical pathology for accurate diagnosis and monitoring of diseases.
- 4 Apply quality control measures and ensure safety in clinical laboratory practices.

Course Contents

Unit I**11 Hours**

Constituents of blood and bone marrow, Regulation of hematopoiesis. Anemia: classification and clinical features; clinical and lab. approach to diagnosis Pathology. Nutritional anemias: Iron deficiency anemia, Folic Acid/Vit B 12 deficiency anemia including pernicious anemia. Hemolytic Anemias: Classification and investigation.

Unit II**12 Hours**

Hereditary hemolytic anemias: Thalassemia, sickle cell anemia Hereditary hemolytic anemias: hereditary spherocytosis, G-6-PD deficiency Acquired hemolytic anemias, Hemolytic Anemias: Autoimmune, Alloimmune,

Unit III**11 Hours**

Hemostatic disorders: Platelet deficiency; ITP, Drug induced, secondary k) Coagulopathies: Coagulation factor deficiency; hemophilia. Leukocytic disorders: Leukocytosis, leukopenia, Acute and chronic Leukemia: Classification, Diagnosis.

Unit IV**11 Hours**

Blood transfusion: grouping and cross matching, untoward reactions, transmissible infections including HIV and hepatitis. Infectious diseases, new and emerging infectious diseases, categories of infectious diseases in brief, Special techniques for diagnosing infections, Tuberculosis-etiology, pathogenesis and lab diagnosis, Leprosy – etiology, pathogenesis and lab diagnosis, HIV- epidemiology, pathogenesis and lab diagnosis.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Kumar, V., Abbas, A. K., & Aster, J. C. (2014). Robbins and Cotran pathologic basis of disease. Elsevier Health Sciences.*
- *Henry, J. B. (Ed.). (2011). Clinical diagnosis and management by laboratory methods. Saunders.*
- *Jaffe, E. S., Harris, N. L., Vardiman, J. W., & Campo, E. (Eds.). (2016). Hematopathology. Elsevier Health Sciences.*
- *McClatchey, K. D. (Ed.). (2018). Clinical laboratory medicine. Wolters Kluwer.*
- *Rodak, B. F., & Carr, J. H. (2019). Clinical hematology atlas. Elsevier Health Sciences.*
- *Bishop, M. L., Fody, E. P., & Schoeff, L. E. (2013). Clinical chemistry: principles, techniques, and correlations. Lippincott Williams & Wilkins.*
- *Detrick, B., Hamilton, R. G., & Folds, J. D. (Eds.). (2013). Manual of molecular and clinical laboratory immunology. ASM Press.*
- *Stankovic, A. K., Dabbs, D. J., & DeMay, R. M. (Eds.). (2020). Cytopathology. Elsevier Health Sciences.*
- *Mckenney, J. K., McKenney, J. K., Srigley, J. R., & Amin, M. B. (Eds.). (2018). Atlas of urologic surgical pathology. Elsevier Health Sciences.*
- *Weiss, L. M., & Chen, Y. Y. (Eds.). (2014). Modern soft tissue pathology: Tumors and non-neoplastic conditions. Cambridge University Press.*

Course Title: Environmental Toxicology

Course Code: MML112

L	T	P	Cr.
3	0	0	3

Total Hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Identify and evaluate the different classes of environmental toxicants and their associated health and ecological impacts.
- 2 Interpret the principles and concepts of environmental toxicology and its applications in assessing and managing environmental risks.
- 3 Apply risk assessment methodologies to assess the potential risks posed by environmental toxins and develop appropriate mitigation strategies.
- 4 Analyze the toxicokinetics and toxicodynamics of environmental toxins and their effects on human health and ecosystems.

Unit I

11 Hours

Introduction to Environmental Toxicology, Definition and scope of environmental toxicology, Historical development and milestones in the field, Sources, pathways, and fate of environmental toxins, Concepts of dose-response and toxicity.

Unit II

11 Hours

Toxicokinetics and Toxicodynamics, Absorption, distribution, metabolism, and excretion of toxic substances, Factors influencing toxicokinetics (e.g., age, sex, species, route of exposure), Mechanisms of toxic action (toxicodynamics), Receptor-mediated toxicity and signal transduction pathways, Genetic and epigenetic factors in toxicology, Adverse effects of environmental toxins on various organ systems

Unit III

11 Hours

Environmental Toxicants and Their Effects, Classes of environmental toxicants (e.g., heavy metals, pesticides, air pollutants), Health effects of environmental toxins (e.g., carcinogenicity, neurotoxicity, reproductive toxicity), Ecotoxicology and its implications for ecosystems, Bioaccumulation and bio magnification of toxic substances, Case studies of significant environmental toxicants and their impacts, Emerging issues in environmental toxicology (e.g., endocrine disruptors, nanotoxicology).

Unit IV**12 Hours**

Risk Assessment and Mitigation Strategies., Hazard identification and dose-response assessment, Exposure assessment and environmental monitoring, Risk characterization and communication, Environmental regulations and policies, Strategies for environmental remediation and pollution control, Role of environmental toxicologists in public health and environmental protection

Suggested Readings

- *Airns, J., Niederlehner, B. R., & Oris, J. T. (Eds.). (2018). Environmental toxicology: Biological and health effects of pollutants (3rd ed.). CRC Press.*
- *Clarkson, T. W., & Magos, L. (Eds.). (2006). The toxicology of mercury and its chemical compounds. Springer Science & Business Media.*
- *Goullé, J. P., & Barroso, R. (Eds.). (2017). Toxicology and clinical pharmacology of herbal products. Springer.*
- *Hayes, A. W. (Ed.). (2014). Principles and methods of toxicology (6th ed.). CRC Press.*
- *Newman, M. C. (Ed.). (2012). Fundamentals of ecotoxicology (4th ed.). CRC Press.*
- *Rand, G. M. (Ed.). (2010). Fundamentals of aquatic toxicology: Effects, environmental fate and risk assessment (3rd ed.). CRC Press.*
- *Roberts, D. M., & Rehman, F. (Eds.). (2017). Clinical management of poisoning and drug overdose. CRC Press.*
- *Timbrell, J. A. (Ed.). (2013). Introduction to toxicology (3rd ed.). CRC Press.*
- *Verma, R. J. (Ed.). (2017). Environmental toxicology: Selected entries from the Encyclopedia of sustainability science and technology. Springer.*

Semester: 2nd**Course Title: Advanced Techniques in Bacteriology****Course Code: MML201**

L	T	P	Cr.
4	0	0	4

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Characterize and Identify bacterial pathogen present in samples.
- 2 Illustrate morphology, biochemical reactions, to differentiate bacterial biomarkers.
- 3 Differentiate bacterial pathogen screening by using screening tool.
- 4 Demonstrate the additional screening tools of laboratory diagnosis cancer.

Course Contents**UNIT-I****14 Hours**

Characterization of bacterial pathogen directly in clinical specimens: Nucleic acid Amplification test, Advancement in PCR Technology e.g. Qualitative Real Time PCR, Next Generation Sequencing (NGS), Multiplex PCR, Nested PCR, Real Time PCR, MALDI-MS.

UNIT-II**16 Hours**

Biomarkers and Algorithms for diagnosis of Ovarian Cancer: Human Epididymis Protein 4 (HE-4), Diadnosis of HE 4 in Ovarian Cancer,CA 125 marker of Ovarian Cancer,serum CA 124 assay for the detection of early stage ovarian cancer, marker of Ovarian Cancer Risk of Malignancy Index (RMI), Risk of Ovarian Malignancy Algorithm (ROMA).

UNIT-III**13 Hours**

Biomarkers in Ovarian Pathology screening to diagnosis: Neoplasm, Ovarian Neoplasm, Ovarian Cancer (OC), High grade Serious Carcinoma (HGSC).

Multimodality Screening – Prostate, Lung, Colorectal, Ovarian Cancer (PLCO) screening.

UNIT-IV

17 Hours

Screening Tools: OVA 1 Test, Additional Biomarkers: Apolipoprotein A1 (Apo A1) Beta 2 microglobulin, transferrin, Mass Spectrometry based Proteomics: Ovarian Cancer, Gynecology Oncology, Epithelial Ovarian Cancer – standard and cut-off values of serum ca-125, HE4 and ROMA, Carbohydrate 125.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Magdalena Elwira Zokowska, (2021). "Advanced methods of bacteriological identification in clinical microbiology laboratory" J. Pre Clin Clin Res. 15 (2) 68-72.*
- *V. Dochez, H Callion, E. Vaucel, J Dimet, (2019), Biomarkers and algorithms for diagnosis of ovarian cancer: CA125, HE4, RMI and ROMA – A review Journal of Ovarian*
- *K. Al Musahi, M Al Kindi, F Al Aisary (2016) "Evaluation of HE4, CA-125, risk of ovarian malignancy algorithm (ROMA) and risk of malignancy index (RMI) in the preoperative assessment of patients with adnexal*

Course Title: Mycology and Virology**Course Code: MML211**

L	T	P	Cr.
4	0	0	4

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Describe various properties of virus, pathogen city, and transmission of virus.
- 2 Cultivate virus and purification of virus strains.
- 3 Demonstrate the classification of fungi, media used for culturing fungi.
- 4 Apply molecular techniques used for the diagnosis of fungal infection.

Course Contents

UNIT-I**14 Hours**

General Properties of Viruses: Origin of virology, properties of viruses, classification and nomenclature of viruses, structure of viruses, capsid symmetry and architecture, DNA & RNA viruses: Transmission of viruses, epidemiology of viral infection, prevention and control measures of viral infection, molecular techniques for clinical diagnosis of viral diseases.

UNIT-II**16 Hours**

Cultivation and Purification of Viruses: Cultivation, isolation, purification and virus assays, virus receptors, interaction with host cell, attachment and penetration, uncoating and replication, lysogenic and lytic bacteriophages, lysogeny with special reference to lambda and mu phages, Pathogenicity, clinical features, laboratory diagnosis, immune prophylaxis and prophylaxis: Dengue, Japanese encephalitis, Yellow fever, Kyasanur forest disease, Polio, Influenza virus, Rubella virus, Hepatitis, HIV, Smallpox, Rabies, Rotavirus and Oncovirus.

UNIT-III**16 Hours**

Introduction to medical mycology: Introduction and classification of fungi, media used for culturing fungi, chemotherapeutic agents for fungi,

mechanism of resistance of chemotherapeutic agents, Pathogen city, clinical features and laboratory diagnosis of superficial and subcutaneous mycosis: Dermatophytoses, Piedra, Tinea nigra, Tinea versicolor, chromoblastomycosis, mycetoma, sporotrichosis and rhinosporidiosis.

UNIT-IV

14 Hours

Pathogenicity, clinical features and laboratory diagnosis of systemic mycosis and opportunistic mycosis: Paracoccidioidomycosis, coccidioidomycosis, histoplasmosis, blastomycosis, cryptococcosis candidiasis, aspergillosis, penicillosis, Molecular techniques: Recent molecular techniques used for the diagnosis of fungal infection

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Ananthanarayan, R. (2006). Ananthanarayan and Paniker's textbook of microbiology. Orient Blackswan*
- *Panjarathinam, R. (2007). Medical microbiology. New Age International.*
- *Kumar, S. (2012). Textbook of microbiology. JP Medical Ltd.*
- *Wiley, J. M., Sherwood, L., & Woolverton, C. J. (2011). Prescott's microbiology (Vol. 7). New York: McGraw-Hill.*
- *Tortora, G. J., Funke, B. R., & Case, C. L. (2007). Microbiology: an introduction (p. 912). San Francisco, CA: Pearson Benjamin Cummings.*
- *Lederberg, J. (2000). Encyclopedia of microbiology, four-volume set. Academic Press.*
- *Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). Textbook of diagnostic microbiology-e-book. Elsevier Health Sciences.*
- *Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). Koneman's color atlas and textbook of diagnostic microbiology. Jones & Bartlett Publishers.*

Course Title: Molecular Biology and Applied Genetics**Course Code: MML212**

L	T	P	Cr.
4	0	0	4

Total Hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Critically evaluate scientific literature in molecular biology and genetics.
- 2 Demonstrate the molecular basis of genetic disorders, such as inherited diseases and cancer, and understand the role of genetic variation in disease
- 3 Analyze and interpret genetic data obtained from experiments or databases.
- 4 Anticipate, analyze and interpret the results of an experimental design.

Unit I**15 Hours**

Introduction to molecular biology and genetics, Central dogma of molecular biology, DNA replication and repair, Transcription and translation, Genetic code and protein synthesis, Techniques in molecular biology

Unit II**15 Hours**

Genetics and Inheritance, Mendelian genetics, Chromosomal theory of inheritance, Sex determination and sex-linked inheritance, Non-Mendelian inheritance patterns, Genetic variation and population genetics, Linkage and genetic mapping

Unit III**15 Hours**

Molecular Genetics and Gene Regulation, DNA structure and organization, Gene expression and regulation, Transcriptional control mechanisms, Post-transcriptional and translational control, Epigenetics and chromatin remodeling, Recombinant DNA technology and genetic engineering

Unit IV**15 Hours**

Genomics and Applications of Molecular Biology, Genomics and functional genomics, Comparative genomics and evolution, Molecular basis of human genetic diseases, Cancer genetics and molecular oncology, Gene therapy and

genetic engineering applications, Molecular diagnostics and personalized medicine

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- Strachan, T., & Read, A. P. (2010). Human molecular genetics (4th ed.). Garland Science.
- Vogelstein, B., & Kinzler, K. W. (2013). The genetic basis of human cancer (2nd ed.). McGraw-Hill Education.
- Brown, T. A. (2017). Gene cloning and DNA analysis: An introduction (7th ed.). Wiley-Blackwell.
- Sambrook, J., Russell, D. W., & Sambrook, J. (2001). Molecular cloning: A laboratory manual (3rd ed.). Cold Spring Harbor Laboratory Press.

**Course Title: Advanced Techniques in Bacteriology
(Practical)**

Course Code: MML213

L	T	P	Cr.
0	0	4	2

Total Hours 30

Course Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Characterize and Identify bacterial pathogen present in samples.
- 2 Illustrate morphology, biochemical reactions, to differentiate bacterial biomarkers.
- 3 Differentiate bacterial pathogen screening by using screening tool.
- 4 Use additional screening tools of laboratory diagnosis cancer.

Course Contents

List of Practical / Experiments

1. To characterized bacterial pathogen directly in clinical specimens.
2. To diagnose ovarian cancer with HE-4 marker.
3. To diagnose ovarian cancer with CA125 marker.
4. To diagnose early stage of ovarian cancer.in serum with CA124 assay.
5. To diagnose prostate, lung, colorectal, ovarian cancer by High Grade Serious Carcinoma (HGCS) multimodality screening.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- Magdalena Elwira Zokowska, (2021). "Advanced methods of bacteriological identification in clinical microbiology laboratory" *J. Pre Clin Clin Res.* 15 (2) 68-72.
- V. Dochez, H Callion, E. Vaucel, J Dimet, (2019), *Biomarkers and algorithms for diagnosis of ovarian cancer: CA125, HE4, RMI and ROMA – A review Journal of Ovarian*
- K. Al Musahi, M Al Kindi, F Al Aisary (2016) "Evaluation of HE4, CA-125, risk of ovarian malignancy algorithm (ROMA) and risk of malignancy index (RMI) in the preoperative assessment of patients with adnexal.

Course Title: Mycology and Virology (Practical)

Course Code: MML214

L	T	P	Cr.
0	0	4	2

Total Hours 30

Course Learning Outcomes: On completion of this course, the successful students will be able to

- 1 Apply various procedures for diagnosis of various viruses, fungal organism from samples.
- 2 Perform staining techniques for identification of fungi.
- 3 Prepare culture media for isolation of fungi from various samples.
- 4 Collect samples from skin, nail, and hair, for identification of fungal agent.

Course Contents

List of Practical's / Experiments:

1. To perform serodiagnosis of HIV infection kit by tridot kit.
2. To perform serodiagnosis of Hepatitis B by cassette method.
3. To perform staining of fungi by lacto phenol cotton blue
4. To isolate and identify fungi from skin sample.
5. To isolate and identify fungi from hair sample.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan
- Panjarathinam, R. (2007). *Medical microbiology*. New Age International.
- Kumar, S. (2012). *Textbook of microbiology*. JP Medical Ltd.
- Willey, J. M., Sherwood, L., & Woolverton, C. J. (2011). *Prescott's microbiology* (Vol. 7). New York: McGraw-Hill.

- Tortora, G. J., Funke, B. R., & Case, C. L. (2007). *Microbiology: an introduction* (p. 912). San Francisco, CA: Pearson Benjamin Cummings.
- Lederberg, J. (2000). *Encyclopedia of microbiology, four-volume set*. Academic Press.
- Mahon, C. R., Lehman, D. C., & Manuselis, G. (2018). *Textbook of diagnostic microbiology-e-book*. Elsevier Health Sciences.
- Procop, G. W., Church, D. L., Hall, G. S., & Janda, W. M. (2020). *Koneman's color atlas and textbook of diagnostic microbiology*. Jones & Bartlett Publishers

Course Title: First Aid**Course Code: MML203**

L	T	P	Cr
2	0	0	2

TOTAL HOURS 30

Course Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Provide First Aid in emergency conditions
- 2 Demonstrate the techniques of assessing life saving measures for any casualty
- 3 Explain First Aid management for respiratory problems, injuries, circulatory problems
- 4 Identify and give First Aid treatment in community emergencies and natural disorders

Course Contents

UNIT I 10 Hours

First aid: Aims and objectives of first aid; wounds and bleeding, dressing and bandages; pressure and splints, supports etc. Shock; insensibility; asphyxia; convulsions; resuscitation, use of suction apparatus; drug reactions; prophylactic measures; administration of oxygen; electric shock; burns; scalds; hemorrhage; pressure points; compression band.

UNIT II 05 Hours

Fractures; splints, bandaging; dressing, foreign bodies; poisons.

UNIT III 07 Hours

Infection: Bacteria, their nature and appearance; spread of infections; auto-infection or cross-infection; the inflammatory process; local tissue reaction, general body reaction; ulceration; Asepsis and antisepsis. Universal precautions, hospital acquired infections- HIV, Hepatitis B, C, and MRSA etc.

UNIT IV 08 Hours

Principles of Asepsis: Sterilization - methods of sterilization; use of central sterile supply department; care of identification of instruments, surgical dressings in common use, including filament swabs, elementary operating theatre procedure; setting of trays and trolleys in the radio imaging department

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *The authorized manual of St. John Ambulance, St. Andrew's Ambulance association and the British red cross society, First Aid manual, 9th edition, Dorling Kindersley, London*
- *American college of emergency physicians, First Aid manual, 5th edition, Dorling Kindersley, London*
- *Clement Text book on First Aid & Emergency Nursing, First edition, JP brothers, 2012*
- *Philip Jevon, Emergency care and First Aid for Nurses, A practical guide, Churchill Living Stone, 2007*

Course Title: Medical Parasitology

Course Code: MML215

L	T	P	Cr
3	0	0	3

Total Hours 45

Course Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Perform laboratory tests for the identification and detection of parasitic infections accurately and effectively.
- 2 Apply knowledge of different specimen collection methods, preparation techniques, and appropriate tests for specific parasites.
- 3 Integrate laboratory results with clinical information to make informed decisions regarding the management and treatment of patients with parasitic infections.
- 4 Critically evaluate the strengths and limitations of each diagnostic technique, considering factors such as sensitivity, specificity, cost, and ease of implementation.

Unit I

11 Hours

Introduction to Medical Parasitology, Basic concepts in parasitology, Classification and taxonomy of parasites, Host-parasite relationship, Modes of transmission, Laboratory techniques in parasitology, Diagnostic methods for parasite identification

Unit II

11 Hours

Introduction to protozoan parasites, Classification and characteristics of major protozoan parasites, Clinical manifestations and pathology associated with protozoan infections, Epidemiology and distribution of protozoan parasites, Diagnostic methods for protozoan parasite identification, Treatment and prevention of protozoan infections

Unit III

11 Hours

Introduction to helminth parasites, Classification and characteristics of major helminth parasites (nematodes, cestodes, trematodes), Clinical manifestations and pathology associated with helminth infections, Epidemiology and distribution of helminth parasites, Diagnostic methods for

helminth parasite identification, Treatment and prevention of helminth infections

Unit IV

12 Hours

Arthropod Parasites, Introduction to arthropod parasites, Classification and characteristics of major arthropod parasites (ticks, mites, lice, fleas), Clinical manifestations and pathology associated with arthropod parasite infestations, Epidemiology and distribution of arthropod parasites, Diagnostic methods for arthropod parasite identification, Treatment and prevention of arthropod infestations

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- Sharma, S. (2019). Medical Parasitology: Principles and Practice. New Delhi, India: Jaypee Brothers Medical Publishers.
- Das, P. K. (2019). Medical Parasitology: A Comprehensive Guide. New Delhi, India: XYZ Publishers.
- Gupta, R. K. (2021). Medical Parasitology: Principles and Practice. New Delhi, India: Jaypee Brothers Medical Publishers.

Course Title: Transfusion Medicine

Course Code: MML216

L	T	P	Cr
3	0	0	3

Total Hours 45

Course Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Perform laboratory tests for the identification and detection of Blood groups accurately and effectively.
- 2 Apply knowledge of different specimen collection methods, preparation techniques, and appropriate tests for specific transfusion.
- 3 Analyze complex transfusion medicine scenarios, identify potential problems, and propose appropriate solutions.
- 4 Critically evaluate the strengths and limitations of each diagnostic technique, considering factors such as sensitivity, specificity, of cross matching.

UNIT I

11 Hours

Introduction to Transfusion Medicine, Overview of transfusion medicine: definition, scope, and historical background, Blood components and their functions, Blood groups and compatibility testing, ABO and Rh blood group systems, Cross matching and antibody identification, Transfusion-related complications and their prevention

UNIT II

11 Hours

Donor eligibility criteria and selection process, Blood donor screening for infectious diseases (HIV, hepatitis B and C, syphilis, etc.), Screening tests for transfusion-transmissible infections, Donor adverse events and reactions, Donor deferral criteria and management

UNIT III

11 Hours

Blood collection techniques: venipuncture, apheresis, and whole blood collection, Blood component preparation: red blood cells, platelets, plasma, cryoprecipitate, etc. Processing and storage of blood components, Quality control and monitoring of blood products, Blood product inventory management and distribution

UNIT IV

12 Hours

Transfusion Practice and Complications, Indications and selection of blood products for transfusion, Pre-transfusion testing and crossmatching procedures, Administration of blood and blood components, Transfusion reactions and their management, Hemolytic transfusion reactions and transfusion-associated infections, Immunohematology and specialized transfusion services (neonatal transfusion, autoimmune disorders, etc.)

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Agarwal, R. K. (2021). Transfusion Medicine: Principles and Practice. New Delhi: ABC Publications.*
- *Sharma, R. K. (2019). Transfusion Medicine: Principles and Practice. New Delhi, India: Jaypee Brothers Medical Publishers.*
- *Ghosh K. (2019). Transfusion Medicine: Technical Manual. New Delhi, India: Jaypee Brothers Medical Publishers.*

Course Title: Biomedical Techniques & Laboratory Management

Course Code: MML217

L	T	P	Cr
3	0	0	3

Total Hours 45

Course Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Perform laboratory tests for the identification and detection of Blood groups accurately and effectively.
- 2 Apply knowledge of different specimen collection methods, preparation techniques, and appropriate tests for specific transfusion.
- 3 Analyze complex transfusion medicine scenarios, identify potential problems, and propose appropriate solutions.
- 4 Critically evaluate the strengths and limitations of each diagnostic technique, considering factors such as sensitivity, specificity, of cross matching.

UNIT I

11 Hours

Introduction to Biomedical Techniques and Laboratory Management, Overview of biomedical research and clinical laboratories, Roles and responsibilities of laboratory personnel, Laboratory safety protocols and regulations, Ethical considerations in laboratory research

UNIT II

11 Hours

Biomedical Techniques I: Molecular Biology, DNA extraction and purification techniques, Polymerase Chain Reaction (PCR), Gel electrophoresis and DNA sequencing, Gene expression analysis methods (e.g., qPCR, microarray)

UNIT III

11 Hours

Biomedical Techniques II: Cell Culture and Protein Analysis, Principles of cell culture and maintenance, Cell-based assays and cytotoxicity testing, Western blotting and immunohistochemistry, Enzyme-linked immunosorbent assay (ELISA)

UNIT IV

11 Hours

Laboratory Management and Quality Control, Laboratory organization and workflow optimization, Inventory management and equipment maintenance, Documentation and record-keeping, Quality control and assurance in laboratory operations, Regulatory Compliance and Ethical Considerations, Good Laboratory Practices (GLP) and Good Clinical Practices (GCP), Regulatory agencies and guidelines (e.g., FDA, ICH), Ethical considerations in research involving human subjects and animals, Intellectual property and patents in the biomedical field, Scientific writing and publication ethics.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- "Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook is a classic reference for molecular biology techniques.
- "Fundamentals of Light Microscopy and Electronic Imaging" by Douglas B. Murphy is a great resource for understanding microscopy techniques.
- "Project Management for the Pharmaceutical Industry" by Laura Brown and Tony Grundy offers insights into project management specifically tailored for laboratories.
- "Laboratory Management: Principles and Processes" by Denise M. Harmening is a comprehensive handbook covering laboratory management principles.

Course Title: Clinical Enzymology

Course Code: MML218

L	T	P	Cr
3	0	0	3

Total Hours 45

Course Learning Outcomes: On completion of this course, the learner will be able to:

- 1 Develop a comprehensive understanding of the biochemical and physiological properties of enzymes.
- 2 Explore the diagnostic applications of enzymes in clinical practice.
- 3 Analyze complex and interpret clinical enzyme data.
- 4 Identify role of enzymes in disease diagnosis, monitoring, and therapeutic interventions.

Course Content

UNIT I

12 Hours

Introduction to Clinical Enzymology, Enzymes: Structure, function, and classification, Enzyme kinetics and regulation, Clinical significance of enzymes, Laboratory Techniques in Clinical Enzymology, Principles of enzyme assays, Spectrophotometry and colorimetry, Electrophoresis and immunological methods, Enzyme-linked immunosorbent assays (ELISA)

UNIT II

11 Hours

Diagnostic Enzymes, Cardiac enzymes (troponins, CK-MB, LDH), Liver function enzymes (ALT, AST, ALP, GGT), pancreatic enzymes (amylase, lipase), renal function enzymes (creatinine kinase).

UNIT III

11 Hours

Enzymes in Disease Diagnosis, Enzymes as biomarkers in cardiovascular diseases, Enzymes in liver diseases, Enzymes in pancreatic diseases, Enzymes in renal diseases, Enzymes in Therapeutic Monitoring, Therapeutic drug monitoring and enzymes, Enzymes in monitoring cancer treatment, Enzymes as indicators of tissue damage and repair, Enzyme Disorders and Inborn Errors of Metabolism.

UNIT IV

11 Hours

Genetic enzyme deficiencies and their clinical manifestations, Enzyme replacement therapy, Quality Control and Assurance in Clinical Enzymology,

External quality assessment schemes, Reference ranges and standardization, Case Studies and Interpretation of Clinical Enzyme Data, Analysis and interpretation of enzyme profiles in specific diseases, Correlation of enzyme levels with clinical symptoms and outcomes.

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer

Suggested Readings

- *Chatterjee, B. K., & Majumder, R. (2019). Clinical Enzymology: A Textbook. New Delhi, India: Jaypee Brothers Medical Publishers.*
- *Smith, J. K. (2019). Clinical Enzymology: Principles and Applications. New York, NY: ABC Publishing.*
- *Robinson, G. R., & Bird, M. R. (2019). Clinical Enzymology: Principles and Applications. Springer.*

Semester 3rd**Course Title: Research Methodology****Course Code:MML312**

L	T	P	Cr.
4	0	0	4

Total Hours: 60

Course Learning Outcomes: On successful completion of this course, the learner will be able to:

1. Prioritize the needs of research in the clinical field of Radiology.
2. Choose the appropriate research design and develop appropriate research hypothesis for a research project.
3. Describe the appropriate statistical methods required for a particular research design
4. Develop the ability to apply the methods while working on a research project work

Course Contents**UNIT I****15 Hours**

Research: its concept, nature, scope, need and Objectives of Research, Research types, Research methodology, Research process – Flow chart, description of various steps, Selection of research problem.

UNIT-II**15 Hours**

Research Design: Meaning, Objectives and Strategies of research, different research designs, important experimental designs, Methods of Data Collection and Presentation: Types of data collection and classification, Observation method, Interview Method, Collection of data through Question-Answernaires, Schedules, data analysis and interpretation, editing, coding, content analysis and tabulation.

UNIT-III**15 Hours**

Sampling Methods: Different methods of Sampling : Probability Sampling methods , Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling and Multistage Sampling. Non probability Sampling methods, Sample size.

UNIT-IV**15 Hours**

Report writing and Presentation: Types of reports, Report Format – Cover page, Introductory page, Text, Bibliography, Appendices, Typing instructions, Oral Presentation

Transactional modes

Video based teaching, Collaborative teaching, Case based teaching, Question-Answer,

Suggested Readings

- *Panneerselvam, R, 'Research Methodology', PHI, New Delhi.*
- *Cooper, D.R.,Schindler,P.S., 'Business Research Methods,' Tata McGraw Hill Gupta S P,' Statistical Methods', Sultan Chand & Sons, Delhi*
- *Ronald E Walpole, 'Probability and Statistics for Engineers and Scientists' (International Edition), Pearson Education. Geode, Millian J. & Paul K. Hatl, "Methods in Research", McGraw Hills, New Delhi.*
- *Kothari C.R., "Research Methodology", New Age Publisher Nargundkar R, Marketing Research, Tata McGraw Hill, New Delhi, 2002. Sekran, Uma, "Business Research Method", Miley Education, Singapore.*

Course Title: Research Proposal

Course Code: MML313

L	T	P	Cr.
2	0	4	4

Total Hours: 60

Course Learning Outcomes: On successful completion of this course, the learner will be able to:

1. Introduce Research proposal and its various aspects
2. Study about Ethical problems in Research and Research design
3. Demonstrate various research tools.
4. Analyze the different research problem and Ethical issues in Research.

Course Contents

UNIT I

10 Hours

Research Methodology Introduction to research methods identifying research problem Ethical issues in research design

UNIT II

15 Hours

Data Collection Experimental and non-experimental research designs Sampling methods, data collection, observation methods Interview method, Question-Answeraries' and schedules construction

UNIT III

15 Hours

Research Frame Work Ethical issues in research Principles and concepts in research ethics-confidentiality and privacy informed consent writing research proposals Development of conceptual framework in research

UNIT-IV

20 Hours

Rationale Basic principles of research and methods applied to draw inferences from the research findings. Measures of Dispersion, Skewness and kurtosis, Sampling, Sample size determination, Introduction and method of collecting and presenting statistical data. Calculation and interpretation of various measures like mean, median, standard deviations, Skewness and Kurtosis, Probability distribution, Correlation and regression Significance tests and confidence intervals

List of Experiment/Practical

- Understanding the purpose and importance of a research proposal. Identifying research topics and formulating research Question-Answers
- Reviewing relevant literature and conducting a literature search, Ethical considerations in research proposal development
- Research Design and Methodology, selecting appropriate research designs (quantitative, qualitative, mixed methods)
- Sampling techniques and sample size determination, Data collection methods (surveys, interviews, observations, experiments), Instrument development and validation
- Data analysis techniques and statistical considerations
- Components of a Research Proposal, Title and abstract writing, Introduction and background section
- Research objectives and hypotheses, Methodology and study design, Data analysis plan and statistical considerations, Timeline and budget development
- Refining and Presenting the Research Proposal, Peer review and feedback process
- Revision and refinement of the research proposal, Oral presentation skills for research proposals
- Finalizing the research proposal and preparing it for submission, Funding opportunities and grant writing basics,
- Ethical Considerations and Institutional Review Boards (IRBs)
- Understanding ethical guidelines for research involving human subjects
- Writing an IRB application and addressing ethical concerns
- Presenting the research proposal to an audience and defending its merits
- Incorporating feedback and finalizing the research proposal

Transaction Mode-

Video based teaching, collaborative teaching, case based teaching, Question-Answer

Suggested Readings

- *Kothari, Chakravanti Rajagopalachari. Research methodology: Methods and techniques. New Age International, 2004.*
- *Mahajan, B. K., & Lal, S. (1999). Methods in biostatistics for medical students and research workers. Indian Journal of Community Medicine, 24(3), 140.*
- *Spiegel, M. R., Schiller, J. J., & Srinivasan, R. A. (2013). Schaum's outline of probability and statistics. McGraw-Hill Education.*

Course Title: Ethics & IPR

Course Code: MML314

L	T	P	Cr.
2	0	0	2

Total Hours: 30

Course Learning Outcomes: On successful completion of this course, the learner will be able to:

1. Explain different kind of ethics and values.
2. Apply professional ethics in business.
3. Explain the role of IPRs in professional life.
4. Elucidate the importance of patents and copyrights

Course Contents

UNIT I

07 Hours

Ethics: definition, moral philosophy, nature of moral judgments and reactions, scope, Ethics with respect to science and research, Intellectual honesty and research integrity Scientific misconducts:

UNIT II

08 Hours

Falsification, Fabrication, and Plagiarism (FFP) Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and Misrepresentation of data, Publication ethics: definition, introduction and importance.

UNIT-III

08 Hours

Introduction to Intellectual Property rights: Concept & theories, Kinds of intellectual Property Rights, Advantages & Disadvantages of IPR, Development of IPR in India, Role & Liabilities of IPRs in India.

UNIT-IV

07 Hours

Rights of trademark-kind of signs used as trademark-types, purpose & Functions of a trademark, trademark protection, trademark registration, selecting and evaluating trade mark, trade mark registration process.

Transaction Mode-

Video based teaching, collaborative teaching, case based teaching, Question-Answer

Suggested Readings

- *"Ethics: Theory and Practice" by Jacques P. Thiroux and Keith W. Krasemann*

- *"Practical Ethics" by Peter Singer*
- *"Understanding Intellectual Property Law" by Donald S. Chisum, Tyler T. Ochoa, and Shubha Ghosh.*
- *"Intellectual Property: Patents, Trademarks, and Copyrights" by Richard Stim*

Course Title: Proficiency in Teaching

Course Code: MML315

L	T	P	Cr.
0	0	4	2

Total Hours: 30

Course Learning Outcomes: On successful completion of this course, the learner will be able to:

1. Design and develop learner-centered instructional plans and learning outcomes.
2. Apply innovative teaching strategies and technologies to engage learners.
3. Explore different assessment methods to evaluate student learning.
4. Develop effective communication and classroom management skills.

Course Content

UNIT I

15 Hours

Overview of the course and its objectives - Theories of learning and their implications for teaching - Understanding the role of the teacher and student in the learning process - Writing clear and measurable learning outcomes - Meaning Nature, definition, scope and importance Pedagogy, Andragogy and Heutagogy – Skills based approach to teaching (Teaching skills), Micro-teaching, Macro teaching. Methods and approaches of teaching - CAM, Structure function approach, Synthetic and Analytic approach, Jurisprudential enquiry model

UNIT II

15 Hours

Understanding the diverse needs and backgrounds of learners - Creating an inclusive and supportive learning environment - Facilitating active learning and student engagement strategies Lectures, discussions, and demonstrations - Group work, collaborative learning, and cooperative learning - Problem-based learning, case studies, and simulations

UNIT III

15 Hours

Integrating technology tools into instruction – Online, blended learning, flipped learning and M-learning approaches - Using educational software and platforms effectively Formative and summative assessment methods – Difference between Assessment, Evaluation and Measurement, E-assessment tools

UNIT IV

15 Hours

The importance of reflective practice in teaching - Self-assessment and evaluation of teaching effectiveness – Need of Professional development -

Teaching in multicultural and international classrooms - Culturally responsive teaching practices Meaning, Definition of teaching model, Assumptions, Importance, Role and type of teaching models. Historical teaching model, Philosophical model of teaching

Transaction Mode

Discussions, Case Studies, Microteaching, Classroom Observations, Peer Teaching: Video

Analysis, Role-Playing, Teaching Demonstrations, Classroom Simulations, Reflective

Journals/Blogs, Teaching Portfolios and Technology Integration

Suggested Readings

- *Das, R.C. (1993): Educational Technology – A Basic Text, Sterling Publishers Pvt. Ltd. Evaut, M. The International Encyclopaedia of Educational Technology.*
- *Graeme, K. (1969): Blackboard to Computers: A Guide to Educational Aids, London, Ward Lock. Haas, K.B. and Packer, H.Q. (1990): Preparation and Use of Audio Visual Aids, 3rd Edition, Prentice Hall, Inc Haseen Taj (2006):modern Educational Technology,Agra : H.P Bhargava Book House.*
- *Kumar, K.L. (2008): Educational Technology, New Age International Pvt. Ltd. Publishers, New Delhi (Second Revised Edition).*
- *Mukhopadhyay, M. (1990): Educational Technology – Year Book 1988, All India Association for Educational Technology, New Delhi.*
- *Bruce R Joyce and Marsha Weil, Models of Teaching, Prentice Hall of India Pvt Ltd, 1985. Gage N L , Hand book of Research on Teaching, Rand Mc Naly and Co., Chicago, 1968.*
- *Sharma R A, Technology of Teaching, International Publishing House, Meerut, 1988. Siddiqui M S., and Khan M S., Models of Teaching – Theory and Research, Manas Publication, New Delhi, 1991*

Course Title: Service Learning

Course Code: MML316

L	T	P	Cr.
0	0	4	2

Total Hours 30

Course Learning Outcomes: On successful completion of this course, the learner will be able to:

1. Perform Specimen Collection and Handling of various types of biological specimens following proper procedures and protocols.
2. Perform a wide range of laboratory tests, including hematology, clinical chemistry, microbiology, immunology, and blood banking, utilizing appropriate techniques, equipment, and quality control measures.
3. Develop the skills to analyze and interpret laboratory test results accurately, recognizing normal and abnormal values, and identifying potential errors or discrepancies.
4. Apply quality assurance and quality control practices to ensure the accuracy, reliability, and validity of laboratory test results, including proficiency testing and equipment calibration.

Course Title: Computer Lab**Course Code: MML317**

L	T	P	Cr.
0	0	4	2

Total Hours: 30

Course Learning Outcomes: On successful completion of this course, the learner will be able to:

1. Demonstrate the concepts of computer system, Windows operating system, Internet, various storage devices and computer Networks, e-waste
2. Analyze various components and Input output devices used in a computer system.
3. Utilize various applications and software.
4. Creating and manipulating presentation, views, and formatting and enhancing text, and slide with graphs.

Course Contents

UNIT I**05 Hours**

Generating Charts/Graphs in Microsoft Excel, Power Point Presentation, Creating a new document with templates & Wizard, Word basics, Thesis Writing Formats & scientific editing tools. Style Formats (MLA & APA)

UNIT II**05 Hours**

Using Words Drawing Features, Inserting Tables – (Adding, deleting, modifying rows and columns - merging & splitting cells), Using formulas in tables, Converting text to table and vice-versa, Mail Merge tool. Managing Workbooks, Working with Worksheets.

UNIT III**10 Hours**

Introduction of Windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resize minimizing and maximizing, etc.). Introduction to MS- Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.

UNIT IV**10 Hours**

Introduction to Excel: introduction, about worksheet, entering information, saving. Introduction of Operating System: introduction, operating system concepts, types of operating system. Computer Networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.

Transaction Mode

Video based teaching, collaborative teaching, case based teaching, Question-Answer

Suggested Readings

- *Leon & Leon, "Introduction to Computers", Vikas Publishing House, New Delhi Saxena S., "MS Office Xp for Everyone", Vikas Publishing House, New Delhi, 2007 June Jamrich Parsons, "Computer Concepts", Thomson Learning, 7th Edition, Bombay*
- *White, "Data Communications & Computer Network", Thomson Learning, Bombay Comer, "Computer networks and Internet", Pearson Education, 4eRajaraman, V., &Radhakrishnan, T. (2006).*
- *Digital Logic and Computer Organization. PHI Learning Pvt. Ltd..Mehdi, M. M. (2015). Information Technology for Management by. FIIBBusiness Review, 4(1), 46-47.Ram, B. (2000).*
- *Computer fundamentals: architecture and organization. New Age International.Basandara, S. K. (2017).Computers Today,,Galgotia publication PvtLtd.*
- *A first course in computers: Based on Windows Xp& Office. Vikas Publishing House Pvt Ltd.*
- *Sinha P.K. and Sinha, P. (2007) Computer Fundamentals, BPB Publications. Bangia, R. (2008). Computer Fundamentals and Information Technology. Firewall Media.*
- *<https://www.researchgate.net>https://www.youtube.com/playlist?list=PLWPirh4EWFpF_2T13UeEgZWZHc8nHBuXp*

Semester 4th**Course Title: Training/Internship report****Course Code: MML401**

L	T	P	Cr.
0	0	0	20

Total Hours: 300

Course Learning Outcomes: On successful completion of this course, the learner will be able to

1. Prepare and maintain Operation Theatre as well as patients before surgery.
2. Maintain a sterile field and theatre equipment and follow infection control policies.
3. Manage hazardous waste and follow biomedical waste disposal protocols.
4. Demonstrate skills and knowledge to assist anesthetist in handling emergencies.

Course Contents

Students have to carry out a research project (on any topic related to operation theatre technology) under the supervision of a faculty. The project report has to be prepared on the basis of the research work carried out. The assessment is done on the basis of the work done and the presentation and viva.