



**SARDAR PATEL UNIVERSITY**  
University Road P. B. 10  
Vallabh Vidhyanagar-388120 (Gujarat)  
NAAC accredited with Grade 'A'  
(10-01-2023 to 09-01-2028)

Phone: 0692-226808/85; Email: [exam\\_spu@spuvvn.edu](mailto:exam_spu@spuvvn.edu); Website: [www.spuvvn.edu](http://www.spuvvn.edu)

The Government of India notified the **National Commission for Allied and Healthcare Professions (NCAHP)** Act on **March 28, 2021**. As a common regulatory body, the NCAHP Act provides for regulation and maintenance of standards of education and services by Allied and Healthcare Professionals.

## **Mater of Medical Laboratory Science (MMLS)**

### **SEMESTER II - Medical Microbiology**

| Code       | COURSE NAME                                   | L/P       | T         | C         | Hours      | IA         | ESE        | Total      |
|------------|-----------------------------------------------|-----------|-----------|-----------|------------|------------|------------|------------|
| M02MLSMM01 | Essential and Applied Microbiology            | 3         | 1         | 4         | 60         | 30         | 70         | 100        |
| M02MLSMM02 | Systematic Bacteriology                       | 3         | 1         | 4         | 60         | 30         | 70         | 100        |
| M02MLSMM03 | Medical Entomology and Parasitology           | 3         | 1         | 4         | 60         | 30         | 70         | 100        |
| M02MLSMM04 | Immunology and Immunodiagnostics              | 3         | 1         | 4         | 60         | 30         | 70         | 100        |
|            | <b>Practical</b>                              |           |           |           |            |            |            |            |
| M02MLSMM05 | Systematic Bacteriology practical             | 4         | 0         | 2         | 60         | 30         | 70         | 100        |
| M02MLSMM06 | Medical Entomology and Parasitology practical | 4         | 0         | 2         | 60         | 30         | 70         | 100        |
| M02MLSMM07 | Immunology and Immunodiagnostics practical    | 4         | 0         | 2         | 60         | 30         | 70         | 100        |
|            | <b>Total</b>                                  | <b>24</b> | <b>04</b> | <b>22</b> | <b>420</b> | <b>210</b> | <b>490</b> | <b>700</b> |

L: Lecture, T: Tutorial; P: Practical, C: Credit; I: Internal Assessment; ESE: End Semester Examination

### **Course Name: Essential and Applied Microbiology Total Credit = 4 (60 hours)**

**Course Rationale:** This course lays the foundation for comprehending genetic continuity, variability, and expression, as well as the molecular basis of mutation and repair mechanisms. It introduces students to biotechnological applications, microbial strain development, and industrial-scale cultivation techniques. It elaborates gene transfer mechanisms, plasmid biology, and their applications in genetic engineering, offering insight into innovations in medicine. It emphasises the different methods of measurement of growth along with a comprehensive description of environmental and ecological factors that influence growth dynamics and microbial behaviour in natural systems. This course also establishes a link between microbes and different environments such as soil, water and food.

### **Learning Objectives:**

- Discuss the mechanisms and patterns of DNA replication.
- Describe major applications of recombinant DNA technology, including genetically engineered proteins and vaccines.
- Apply techniques to measure microbial growth in terms of cell number, mass, and activity.



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- Analyse how environmental factors (pH, temperature, radiation, oxygen, solutes) affect microbial growth
- Relate microbial indicators to disease prevention and water safety management.
- Evaluate the ecological and health-related significance of soil microorganisms.
- Explain the mechanisms of microbial food spoilage and control strategies.

| UNIT       | <b>M02MLSMM01</b><br><b>Essential and Applied Microbiology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>C=4</b><br><b>(60hr)</b> |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <b>I</b>   | <b>Bioreactors and Fermenters</b> – Principles and Sterilisation Techniques-Definitions and distinctions: bioreactor vs. fermentor, Types of systems: batch, fed-batch, continuous, anaerobic and aerobic setups. Overview of usage: pharmaceutical, food, environmental, and biotechnological applications; Cultivation of bacteria, fungi, and recombinant strains, Fermentation of specialty compounds (e.g. amino acids, organic acids); Role of bioreactors/fermentors in BSL-1 to BSL-3 workflows                                                                                                                                                             | <b>8</b>                    |
| <b>II</b>  | <b>Sterilisation Techniques:</b> Importance in contamination control and safety, Methods: autoclaving, filtration, chemical sterilant, UV/radiation, Sterilisation of air, media, vessels, and inoculum transfer zones, Validation tools: biological indicators, F <sub>0</sub> value, D-value, and cycle qualification. Role of bioreactors/fermentors in BSL-1 to BSL-3 workflows                                                                                                                                                                                                                                                                                 | <b>7</b>                    |
| <b>III</b> | <b>Industrial Microbiology and Biotechnology</b><br><b>Choosing microorganisms for industrial Microbiology and Biotechnology</b><br>Finding microorganisms in nature<br>Genetic Manipulation of Microorganisms<br>Preservation of Microorganisms<br><b>Microorganisms Growth in Controlled Environments:</b><br>Medium Development<br>Growth of microorganisms in an industrial setting<br><b>Major microbial products of Industrial Microbiology:</b><br>Antibiotics, Amino acids, Vitamins, Speciality compounds for use in medicine and Health,<br><b>Biotechnological Applications:</b><br>Biosensors, Microarrays<br><b>Impacts of Microbial Biotechnology</b> | <b>10</b>                   |
| <b>IV</b>  | <b>Bacterial Recombination:</b> General Principles<br><b>Bacterial Plasmids:</b><br>Fertility factors, Resistance factors, Col plasmids, Other types of plasmids<br><b>Applications of Genetic Engineering:</b> Medical Applications, Production of genetically engineered Somatotrophin, Other mammalian proteins and products, Genetically engineered vaccines, Engineering metabolic pathways<br><b>Gene therapy in Humans</b><br><b>Social impact of Recombinant DNA technology</b>                                                                                                                                                                             | <b>6</b>                    |



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|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| V    | <b>Measurement of Microbial Growth:</b><br>Measurement of cell numbers (Haemocytometer, Electronic Counters, Plating Techniques, Membrane filters)<br>Measurement of cell mass (Turbidity measurements, Wet weight, dry weight measurements) Measurement of cell activity<br><b>The influence of environmental factors on growth:</b><br>Solutes and water activity, pH, Temperature, Oxygen concentration, Pressure, Radiation<br><b>Microbial interactions:</b><br>Mutualism, Protocoperation, Commensalism, Predation, Amensalism, Competition, Symbioses in complex ecosystems<br><b>Growth Limitation in natural environments:</b><br>Growth limitation by Environmental factors, Counting viable but non-culturable (VBNC) vegetative prokaryotes, Quorum sensing and microbial populations, Biofilms | 15        |
| VI   | <b>Waters and Disease transmission:</b> Waterborne pathogens and water purification, Sanitary analysis of waters<br><b>Wastewater treatment:</b> Measuring water quality, Waste treatment processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 5         |
| VII  | Soil as an Environment for microorganisms ;Microorganisms in the soil environment ;Soil Microorganisms and Human Health ;Understanding microbial diversity in the soil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 4         |
| VIII | <b>Microorganism Growth in foods:</b> Intrinsic factors, Extrinsic factors<br><b>Microbial Growth and Food Spoilage</b><br><b>Controlling Food Spoilage:</b> Removal of microorganisms, Low Temperature, High Temperature, Water availability, Chemical-based preservation, Radiation, Microbial product-based inhibition<br><b>Detection of Foodborne Pathogens ; Microorganisms as food and food amendments</b>                                                                                                                                                                                                                                                                                                                                                                                           | 5         |
|      | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>60</b> |

**Suggested Reading:**

1. Lansing M. Prescott – *Microbiology*, McGraw-Hill
2. Michael T. Madigan – *Brock Biology of Microorganisms*, Benjamin Cummings, Pearson Education
3. R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
4. Michael J. Pelczar, E.C.S. Chan, Noel R. Krieg – *Microbiology*, McGraw-Hill Education
5. Peter F. Stanbury, Allan Whitaker, Stephen J. Hall – *Principles of Fermentation Technology*, 3rd Edition, Butterworth-Heinemann (Elsevier), 20162
6. J. Cassells – *Bioprocess Engineering: Systems, Equipment and Facilities*, Wiley India Pvt Ltd, 2020
7. World Health Organisation (WHO) – *WHO Technical Report Series on Bioprocess Containment, various volumes including TRS No. 999 and TRS No. 1033*, WHO Publications
8. Centres for Disease Control and Prevention (CDC) & National Institutes of Health (NIH) – *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*, 6th Edition, U.S. Department of Health and Human Services, 2020



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**Course Name: Systematic Bacteriology**

**Total Credit = 4 (60 hours)**

**Course Rationale:** This subject provides information about various types of bacterial culture procedures, staining techniques, and biochemical tests used for the identification of bacteria. Students will learn about the morphological and cultural characteristics, biochemical properties, and laboratory diagnosis of different bacterial species.

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

- Perform bacterial culture techniques.
- Apply appropriate staining methods.
- Conduct biochemical tests for bacterial identification.
- Recognise and interpret the morphological, cultural, and biochemical characteristics of various bacteria.
- Apply laboratory diagnostic methods for bacterial classification and analysis

| UNIT | M02MLSMM02<br>Systematic Bacteriology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | C=4<br>(60hr) |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I    | <b>Fundamentals of Bacterial Staining &amp; Diagnostic Overview:</b> Significance and principles of staining in bacterial taxonomy and diagnostics; Procedures and interpretation of: Simple stain, Negative stain, Gram stain, Albert's stain, Neisser's stain, Ziehl-Neelsen stain, Capsule, Flagella, Spore stains, Fontana stain for spirochetes; Diagnostic relevance tied to bacterial structures and classification; Overview of bacterial groups relevant to human health.                                                                                                                                                 | 10            |
| II   | <b>Biochemical Identification of Bacteria:</b> Diagnostic interpretation and significance of the following tests in systematic classification: Catalase, Coagulase, Indole, Methyl Red, Voges-Proskauer, Urease, Citrate, Oxidase, TSIA, Nitrate reduction, Carbohydrate fermentation, Bile solubility, H <sub>2</sub> S production, Motility, Decarboxylases; Integration of biochemical patterns into genus/species-level diagnosis                                                                                                                                                                                              | 14            |
| III  | <b>Gram-Positive &amp; Gram-Negative Cocci:</b> Study of morphological, cultural, biochemical characteristics, pathogenesis and laboratory diagnosis of – <i>Staphylococcus</i> , <i>Streptococcus</i> , <i>Pneumococcus</i> , <i>Haemophilus</i> , <i>Neisseria gonorrhoeae</i> and <i>Neisseria meningitidis</i>                                                                                                                                                                                                                                                                                                                 | 8             |
| IV   | <b>Enterobacteriaceae:</b> Study of various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of bacteria-Enterobacteriaceae: <i>Escherichia</i> , <i>Citrobacter</i> , <i>Enterobacter</i> , <i>coli</i> , <i>Proteus</i> , <i>Klebsiella</i> , <i>Shigella</i> , <i>Yersinia enterocolitica</i> and <i>Yersinia pestis</i>                                                                                                                                                                                                                                                        | 10            |
| V    | <b>Systemic &amp; Atypical Bacterial Pathogens:</b> Classification, morphology, pathogenicity, and diagnostics of: <i>Corynebacterium</i> , <i>Salmonella</i> , <i>Vibrio</i> , <i>Aeromonas</i> , <i>Plesiomonas</i> , <i>Clostridium</i> species, <i>Mycobacterium tuberculosis</i> complex, <i>M. leprae</i> , <i>Atypical Mycobacteria</i> , <i>Spirochetes</i> : <i>Treponema</i> , <i>Borrelia</i> , <i>Leptospira</i> , <i>Bordetella</i> , <i>Brucella</i> , <i>Mycoplasma</i> , <i>Ureaplasma</i> , <i>Rickettsia</i> , <i>Chlamydia</i> , <i>Actinomyces</i> , <i>Pseudomonas</i> , <i>Burkholderia</i> .<br>Overview of | 16            |



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|    |                                                                                                                                                                                                                                                                                                                                                                               |           |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| VI | Non-sporing anaerobic cocci and bacilli: Classification & Morphology, pathogenicity, and diagnostics of - Anaerobic cocci: <i>Peptostreptococcus</i> , <i>Veillonella</i> ; Anaerobic Gram-positive bacilli: <i>Propionibacterium</i> , <i>Actinomyces</i> spp. (non-sporing); Anaerobic Gram-negative bacilli: <i>Bacteroides</i> , <i>Fusobacterium</i> , <i>Prevotella</i> | 2         |
|    | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                  | <b>60</b> |

### Suggested Readings:

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

**Course Name: Medical Entomology and Parasitology**

**Total Credit = 4 (60 hours)**

**Course Rationale:** This course enables students in medical laboratory science to equip students with an in-depth understanding of morphology, pathogenesis, diagnostics, and control strategies of medically important parasites and arthropod vectors. It supports clinical decision-making and laboratory proficiency in detecting and characterising parasitic infections and vector-borne diseases with health significance.

### Learning Objectives:

- Recognise global priority parasitic diseases and research advances
- Understand the classification and structure of parasites and arthropods of medical importance
- Explain life cycles, disease mechanisms, and host-pathogen interactions of protozoa and helminths
- Identify parasites and vectors using microscopy, serology, and molecular methods
- Analyse vector ecology and apply integrated control measures
- Interpret immunological and molecular diagnostics relevant to parasitology
- Recognise global priority parasitic diseases and research advances in their management



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| UNIT       | <b>M02MLSMM03</b><br><b>Medical Entomology and Parasitology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>C=4</b><br><b>(60hr)</b> |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <b>I</b>   | <b>Introduction to Medical Parasitology &amp; Entomology:</b> scope and relevance; classification of medically important parasites and arthropods; transmission types, host categories, global burden and disease impact, emerging threats. Types of animal association, parasitism, commensalism, symbiosis, host adaptation mechanisms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>6</b>                    |
| <b>II</b>  | <b>Protozoa:</b><br>morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of nonpathogenic: Entamoeba coli, Endolimax nana, Iodamoeba butschlii, Free living Amoebae: Naegleria, Acanthamoeba, Flagellates: Trichomonas, Giardia lamblia, Leishmania, Trypanosoma, Sporozoa: Malarial parasites, Babesia, Toxoplasma gondii, Isospora belli, Cryptosporidium parvum, Cyclospora, Microsporidia Ciliate: Balantidium coli.<br>Explain zoonosis and drug resistance; opportunistic pathogens cause disease primarily in immunocompromised hosts.                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>8</b>                    |
| <b>III</b> | <b>Helminths:</b><br>Classify helminths; compare morphological features, transmission routes, and adaptation mechanisms.<br><b>Trematodes:</b> morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of Schistosoma species, Fasciola species, Fasciolopsis species, Clonorchis species, Paragonimus species<br><b>Cestodes:</b> morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of Taenia species, Echinococcus species, Hymenolepis nana, Diphyllbothrium latum<br><b>Nematodes:</b><br>morphology, life cycle, pathogenesis, laboratory diagnosis, treatment and prevention of Intestinal Nematodes: Ascaris lumbricoides, Ancylostoma duodenale, Necator americanus, Strongyloids stercoralis, Trichinella spiralis, Enterobius vermicularis, Trichuris trichiura, Toxocara species<br>Lymphatic Nematodes: Wuchereria bancrofti, Brugia malayi Subcutaneous tissue Nematodes: Loa loa, Onchocerca volvulus, Dracunculus medinensis | <b>18</b>                   |
| <b>IV</b>  | <b>Introduction of Arthropods:</b><br>classify the arthropods of public health importance; distinguish between vector and vehicle; vector control strategies (environmental control, chemical control, biological control, genetic control) approaches; role of vehicles and vectors in disease spread; Integrated approaches for parasite and vector control in endemic settings; vector surveillance, resistance management. Antiparasitic drugs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>8</b>                    |
| <b>V</b>   | <b>Arthropods of Medical Importance:</b> morphology, life cycle, public health importance and control of Mosquitoes, Sandflies, Tse-tse fly, Blackflies, Fleas, Ticks and Mites, Cyclops, Housefly, Reduviid Bug, bed bug, lice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>8</b>                    |
| <b>VI</b>  | <b>Host-Parasite Immunology:</b> Immune mechanisms against parasites; antigenic variation; vaccine prospects. hypersensitivity reactions; immunodiagnostic assay interpretation,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>6</b>                    |



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|            |                                                                                                                                                                                                                                                                                                              |           |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>VII</b> | <b>Molecular Tools &amp; Research Advances:</b> PCR, LAMP, and sequencing methods; discuss application of proteomics, genotyping in parasite detection; introduce WHO neglected diseases and research foci. Introduces global parasitic disease priorities and current research in diagnostics and vaccines. | <b>6</b>  |
|            | <b>Total</b>                                                                                                                                                                                                                                                                                                 | <b>60</b> |

### Suggested Reading

- C.K. Jayaram Paniker, *Paniker's Textbook of Medical Parasitology*, Jaypee Brothers Medical Publishers
- D.R. Arora & B. Arora – *Medical Parasitology*, CBS Publishers & Distributors
- P. Chakraborty – *Textbook of Medical Parasitology*, New Central Book Agency
- Lynne Shore Garcia – *Diagnostic Medical Parasitology*, ASM Press
- K.D. Chatterjee – *Parasitology in Relation to Clinical Medicine*, CBS Publishers & Distributors
- Praful B. Godkar – *Textbook of Medical Microbiology and Parasitology*, Bhalani Publishing House
- K. Park – *Park's Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publishers
- WHO Technical Reports – *Vector Control and Parasitic Disease Surveillance*

### Course: Immunology and Immunodiagnostics

**Total Credit = 4 (60 hours)**

**Course Rationale:** This course enables students in medical laboratory science to equip students with an in-depth understanding of advanced immunological concepts and diagnostic strategies relevant to infectious disease microbiology. It emphasises molecular mechanisms, immune dysfunctions, and clinical applications of immunodiagnostic technologies.

### Learning Objectives:

- Describe fundamental immune mechanisms involved in microbial defence, inflammation, and hypersensitivity.
- Interpret antigen presentation and MHC associations in infection susceptibility, autoimmunity, and transplant contexts.
- Evaluate immune dysfunctions including immunodeficiencies and autoimmune disorders with reference to microbial interactions.
- Apply principles of vaccine design and immune modulation to microbial pathogens and emerging clinical scenarios.

| <b>UNIT</b> | <b>M02MLSMM04<br/>Immunology and Immunodiagnostics</b>                                                                                                                                                                                                                                                                                                                                | <b>C=4<br/>(60hr)</b> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>I</b>    | <b>Overview of Immunity:</b> Evolution of immunity; innate and adaptive immunity; immunological memory; inflammation mechanisms; immune regulation and tolerance; relevance in infection detection and host defense mechanisms.<br><b>Immune Organs and Cells:</b> Structure and functions of primary and secondary lymphoid organs; influence of microbiota on lymphoid development. | <b>8</b>              |



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|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|      | Classification and roles of immune cells including T lymphocytes, B lymphocytes, natural killer cells, and dendritic cells. Mechanisms of antigen processing and presentation, structural and functional diversity of immunoglobulin molecules, and the production and clinical applications of monoclonal antibodies.                                                                                                                                                                                                                                       |   |
| II   | <b>Complement System &amp; Effector Mechanisms:</b> Overview of activation pathways—classical, alternative, and lectin—and their regulatory mechanisms. Functional roles in host defense, microbial clearance (e.g. <i>Neisseria</i> , <i>Candida</i> ), inflammation, and autoimmune pathology. Diagnostic applications including CH50 and AH50 assays, and relevance in clinical Immunodiagnostics.                                                                                                                                                        | 5 |
| III  | <b>Immune Response:</b> clonal selection theory and its significance in adaptive immune responses; differences between cell-mediated and humoral immunity. <b>Major Histocompatibility Complex &amp; Antigen Presentation:</b> structure, genetic polymorphism, and expression patterns of Major Histocompatibility Complex molecules; their role in presenting processed antigens to lymphocytes; disease associations involving MHC alleles; and their clinical relevance in infection susceptibility, autoimmune conditions and in organ transplantation. | 8 |
| IV   | <b>Lymphocyte Biology:</b> Maturation, activation, differentiation of B lymphocytes and T lymphocytes; structural diversity of T-cell receptors; lymphocyte trafficking and homing mechanisms. <b>Cytokines &amp; Immune Modulators:</b> Classification and roles of cytokines; therapeutic applications; cytokine storm phenomena; kinin cascade and immune modulation                                                                                                                                                                                      | 8 |
| V    | <b>Hypersensitivity &amp; Immune Dysregulation:</b> the classification and pathophysiological mechanisms of hypersensitivity reactions (Type I to Type IV) and their clinical implications in transfusion reactions, allergic disorders, and autoimmune conditions; laboratory strategies to identify hypersensitivity responses.                                                                                                                                                                                                                            | 5 |
| VI   | <b>Immunodeficiency Syndromes:</b> Primary immunodeficiencies; molecular mechanisms; diagnostic approaches; secondary infections post-immunosuppression; microbial vulnerability; relevant diagnostics pathways. <b>Autoimmunity &amp; Tolerance:</b> the mechanisms of central and peripheral immune tolerance; microbial mimicry in autoimmune diseases ( <i>Campylobacter</i> in Guillain-Barré); immunological errors leading to autoimmune diseases such as systemic lupus erythematosus and rheumatoid arthritis; diagnostic markers.                  | 8 |
| VII  | <b>Transplantation Immunology:</b> Immune recognition in allografts and xenografts; pathways of rejection; pharmacological and immunological strategies for immunosuppression; significance of human leukocyte antigen matching; and influence of microbial factors on graft survival. <b>Tumor Immunology:</b> the identification and roles of tumor-associated antigens; immune evasion by pathogens; mechanisms of immunosurveillance.                                                                                                                    | 7 |
| VIII | <b>Immunogenetics &amp; Epigenetics:</b> genetic determinants of immune variability and disease susceptibility; HLA associations with microbial and autoimmune                                                                                                                                                                                                                                                                                                                                                                                               | 3 |



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|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|    | diseases; epigenetic regulation of immune responses; clinical application of immunogenetics and epigenetics in diagnostics and predictive medicine.                                                                                                                                                                                                                                                                                                                                                                  |           |
| IX | <b>Systems Immunology &amp; Immune Profiling:</b> High-throughput immunological assays; transcriptomic & proteomic responses to pathogens; microbiome-immune interactions; bioinformatics for infection tracking.                                                                                                                                                                                                                                                                                                    | 2         |
| X  | <b>Vaccine Design and Immunodiagnostics:</b> Foundational principles of vaccine design and administration, including microbial antigen selection, immune activation, and immunological memory formation.<br><b>Immunodiagnostic techniques</b> ELISA, flow cytometry, and lateral flow assays for detecting microbial infections.<br>Advanced immunotherapies -Chimeric Antigen Receptor T-cell therapy and immune checkpoint blockade therapy and their diagnostic relevance in infection-linked immune modulation. | 4         |
|    | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>60</b> |

**Suggested Reading:**

- Punt, J., Stranford, S., Jones, P., Owen, J.A. – Kuby Immunology, W.H. Freeman
- Parslow, T.G., Stites, D.P., Terr, A.I. – Medical Immunology, McGraw Hill
- Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M. – Roitt's Essential Immunology, Wiley-Blackwell
- Kumar, V., Abbas, A.K., Aster, J.C. – Robbins Basic Pathology, Elsevier
- Gangal, S., Sontakke, S. – Textbook of Basic and Clinical Immunology, Universities Press (India) Pvt. Ltd.
- Subhash Chandra Parija – *Textbook of Microbiology and Immunology*, Elsevier
- S.K. Gupta – *Essentials of Immunology*, Jaypee Brothers Medical Publishers

|  |                                                             |                             |
|--|-------------------------------------------------------------|-----------------------------|
|  | <b>M02MLSMM05</b><br><b>Systemic Bacteriology Practical</b> | <b>C=2</b><br><b>(60hr)</b> |
|--|-------------------------------------------------------------|-----------------------------|

- **Advanced Specimen Collection & Transport:** Selection of specimen type based on clinical suspicion, Aseptic techniques for collection, Transport media and conditions for fastidious organisms
- **Bacteriological analysis** of food, water, and milk using quantitative methods, interpretation based on permissible limits (ICMR/WHO guidelines)
- **Isolation & Identification from Clinical Samples:** Targeted media selection (e.g., XLD, TCBS, CLED), Colony morphology, pigment production, and hemolysis, Biochemical test panels and automated ID confirmation
- **Integrated Diagnostic Strategies:** Stepwise approach to diagnosing UTI, STI, TB, etc., Case-based interpretation and clinical correlation
- **Automation Platforms (Demo/Simulation):** Principle and workflow of VITEK, MALDI-TOF, and Phoenix, Comparative analysis: manual vs. automated results
- **Case-Based Lab Interpretation:** UTI with ESBL-producing *E. coli*, Genital ulcer workup with *Chlamydia* and *Treponema*, TB diagnostics integrating smear, culture, and GeneXpert

**\*Clinical Laboratory rotation/observation can be incorporated wherever possible**

Curriculum for Medical Laboratory Sciences,  
National Commission for Allied and Healthcare Professions, Ministry of Health and Family Welfare



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| No | <b>M02MLSMM06</b><br><b>Medical Entomology &amp; Parasitology Practical</b> | <b>C=2</b><br><b>(60hr)</b> |
|----|-----------------------------------------------------------------------------|-----------------------------|
|----|-----------------------------------------------------------------------------|-----------------------------|

1. Specimen handling and Biosafety-safe specimen collection, transport, labelling, and disposal procedures, Use of PPE and biosafety guidelines, and sample handling.
2. Wet Mount Preparation & Microscopy -Saline and iodine mounts; faecal smear preparation and observation; parasite sketching and labelling
3. Concentration & Staining Methods- Flootation and sedimentation techniques; basic stains (Giemsa, methylene blue); image-based interpretation
4. Identification of Helminth Ova and Larvae- Morphology of ova and larval stages under microscope; faecal concentration spotters
5. Blood Parasite Detection-Thick and thin blood smear preparation; Giemsa staining; malaria and filarial parasite detection
6. Arthropod Identification - using charts, preserved samples, shared slides
7. Case Scenario Integration - disease link discussion; mapping activity with clinical cues
8. Serological Diagnostic Techniques - ELISA and rapid card tests for parasitic infections; result interpretation and trouble-shooting

**\*Clinical laboratory rotation/observation can be incorporated wherever possible**

| No | <b>M02MLSMM07</b><br><b>Immunology and Immunodiagnostics Practical</b> | <b>C=2</b><br><b>(60hr)</b> |
|----|------------------------------------------------------------------------|-----------------------------|
|----|------------------------------------------------------------------------|-----------------------------|

- **Sample Collection & Handling** - Blood, serum, and tissue sampling for immunological assays; biosafety and ethical protocols
- **Peripheral Blood Smear Interpretation** -Identification of major immune cells and lymphoid structures related to infection defense
- **Immunoassays** -Agglutination, flocculation, ELISA, WIDAL, CRP, Coombs, ASLO, and RPR tests
- **Immunoblotting & Lateral Flow Techniques** -Interpretation of infectious disease strips (e.g. malaria, HIV rapid cards)
- **Antibody Titer Estimation** -Dilution-based methods for semi-quantitative antibody analysis
- **Flow Cytometry** -Immunophenotyping of immune cells and gating analysis
- **Immunofluorescence (Direct & Indirect)**-Microscopic detection of immune markers for diagnostic applications
- **Autoimmune Marker Detection** -Rheumatoid Factor, Anti-CCP, and Antinuclear Antibody (ANA) assays
- **Biosafety & Quality Control in Immunodiagnostics** -Practices for accuracy, reproducibility, and documentation in clinical labs
- **Clinical Case Analysis** -Case-based interpretation of immune dysfunction in infectious disease contexts

**\*Clinical laboratory rotation/observation can be incorporated wherever possible**



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### Semester III Medical Microbiology

| Code       | COURSE NAME                           | L/P       | T        | C         | Hours      | IA         | ESE        | Total      |
|------------|---------------------------------------|-----------|----------|-----------|------------|------------|------------|------------|
| M03MLSMM01 | Medical Virology                      | 3         | 1        | 4         | 60         | 30         | 70         | 100        |
| M03MLSMM02 | Medical Mycology                      | 3         | 1        | 4         | 60         | 30         | 70         | 100        |
| M03MLSMM03 | Public Health Microbiology            | 3         | 1        | 4         | 60         | 30         | 70         | 100        |
| M03MLSMM04 | Advances in Microbial Informatics     | 3         | 1        | 4         | 60         | 30         | 70         | 100        |
|            | <b>Practical</b>                      |           |          |           |            |            |            |            |
| M03MLSMM05 | Medical Mycology & Virology practical | 4         | 0        | 2         | 60         | 30         | 70         | 100        |
| M03MLSMM06 | Public Health Microbiology practical  | 4         | 0        | 2         | 60         | 30         | 70         | 100        |
| M03MLSMM07 | Clinical posting                      | 4         | 0        | 2         | 90         | 30         | 70         | 100        |
|            | <b>Total</b>                          | <b>24</b> | <b>4</b> | <b>22</b> | <b>450</b> | <b>210</b> | <b>490</b> | <b>700</b> |

L: Lecture, T: Tutorial; P: Practical, C: Credit; I: Internal Assessment; ESE: End Semester Examination

#### Course: Medical Virology

**Total Credits: 4 (60 hours)**

#### Course Rationale:

This course is designed to provide postgraduate students in medical laboratory technology with an in-depth understanding of virology, including viral pathogenesis, replication strategies, host-virus interactions, and modern approaches to laboratory diagnosis of viral infections. Emphasis will be placed on molecular virology, emerging and re-emerging viral infections, biosafety practices, and the application of cutting-edge diagnostic tools for clinical and public health use.

#### Learning Objectives:

- Describe viral structure, classification, genome organisation, and replication mechanisms of major virus families.
- Explain host-virus interactions, mechanisms of viral pathogenesis, and immune evasion strategies.
- Evaluate molecular and serological techniques used in the detection, quantification, and genotyping of viruses.
- Interpret laboratory results in the context of clinical virology, outbreak investigation, and surveillance.
- Apply biosafety and biosecurity principles in the handling of clinical viral specimens and high-risk pathogens.
- Discuss current trends in antiviral therapy, vaccine development, and viral epidemiology



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| UNIT | M03MLSMM01<br>Medical Virology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | C=4<br>(60hr) |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I    | <b>General Properties of Viruses:</b> Morphology, Viral Hemagglutination, Viral Multiplication, Cultivation of Viruses- Animal inoculations, Egg inoculation, Cell culture, Viral Assay, Assay of Infectivity, Viral Genetics, Non- Genetic Interactions, Classification and Nomenclature of Viruses, Viroids, Prion; Viral genomics and bioinformatics tools                                                                                                                                                                                                                                                                                                                                                                                                                                               | 10            |
| II   | <b>Virus- Host Interactions: Viral Infections:</b> Pathogenesis of Viral Infection, Host Response to Virus Infections; Laboratory Diagnosis of Viral Diseases, Immunoprophylaxis of Viral Diseases, Chemoprophylaxis and Chemotherapy of Virus Diseases;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8             |
| III  | <b>Bacteriophages:</b> Morphology, life cycle, transmission of genetic information, significance of phages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 10            |
| IV   | <b>Orthomyxoviruses:</b> Morphology, Resistance, Antigen classification; Influenza virus- classification, Nomenclature systems, Antigenic variation, Host range, Pathogenicity, Clinical features, Laboratory diagnosis, Immunity, Epidemiology, Immunoprophylaxis, Treatment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 8             |
| V    | <b>Paramyxoviruses:</b> Antigenic Structure and classification <ul style="list-style-type: none"> <li>• Rubella viruses, Mumps virus: Properties, clinical features, complications, Epidemiology, Immunity, Laboratory Diagnosis, Prophylaxis</li> <li>• Parainfluenza viruses:</li> <li>• Clinical features, Epidemiology, Laboratory diagnosis, New Castle Disease viruses (NDV)</li> <li>• Pneumovirus-</li> <li>• Respiratory Syncytial virus (RSV): Clinical features, Epidemiology, Laboratory features, Epidemiology, Laboratory diagnosis, Prophylaxis, Treatment</li> <li>• Morbillivirus</li> <li>• Measles virus: Epidemiology, clinical features, complications, Pathogenicity, Laboratory Diagnosis, Prophylaxis</li> <li>• Nipah and Hendra virus</li> <li>• Human Metapneumovirus</li> </ul> | 12            |
| VI   | <b>Hepatitis viruses:</b> types of viral hepatitis<br>Type A Hepatitis (HAV), Type B Hepatitis (HBV), Type C Hepatitis (HCV), Type D Hepatitis (HDV), Type G Hepatitis (HGV)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 8             |
| VII  | <b>Human Immunodeficiency Virus (HIV)</b><br>Structure, Viral Genes and Antigens, Antigenic Variation and Diversity Of HIV, Resistance, Pathogenicity<br><b>Acquired Immune Deficiency Syndrome (AIDS)</b><br>Clinical features of HIV infection, Laboratory diagnosis, Strategies for HIV testing, Applications of serological tests, Epidemiology and prevention, Prophylaxis, Treatment                                                                                                                                                                                                                                                                                                                                                                                                                  | 8             |
|      | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>60</b>     |



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**Course: Medical Mycology**

**Total Credits 4 (60 hours)**

**Course Rationale:**

This course is designed to equip postgraduate students in medical laboratory science with advanced knowledge of fungal biology, pathogenesis, host immune response, and modern diagnostic approaches for medical mycology. It emphasises clinically important fungi, emerging fungal infections, antifungal resistance, and laboratory safety in handling fungal pathogens.

**Learning Objectives:**

- Describe the morphology, classification, and reproductive strategies of medically important fungi.
- Explain the pathogenesis of superficial, subcutaneous, systemic, and opportunistic fungal infections.
- Evaluate immune responses to fungal pathogens, including innate and adaptive mechanisms.
- Apply conventional, biochemical, and molecular techniques for the identification and diagnosis of fungal infections.
- Interpret antifungal susceptibility testing and understand resistance mechanisms.
- Implement biosafety protocols and quality assurance in mycology laboratories.

| UNIT | M03MLSMM02<br>Medical Mycology                                                                                                                                                                                                                                                                                                                                           | C=4<br>(60hr) |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I    | <b>Introduction to Mycology:</b> Characteristics of fungi, classification, laboratory diagnosis, treatment; immune responses to fungal pathogens, antifungal therapy.                                                                                                                                                                                                    | 8             |
| II   | <b>Superficial and Subcutaneous Mycosis:</b><br>Classification of Mycoses- Superficial Mycoses:<br>Surface Mycoses: Pityriasis Versicolor (Tinea Versicolor), Tinea Nigra, Piedra<br>Cutaneous Mycoses- Dermatophytoses<br>Deep Mycoses- Subcutaneous Mycoses: Mycetoma, Chromomycosis, Sporotrichosis, Rhinosporidiosis, Subcutaneous Zygomycosis, Entomophthoromycoses | 18            |
| III  | <b>Systemic Mycoses:</b> Systemic Mycoses (Dimorphic Fungi), Blastomycosis, Paracoccidioidomycosis, Coccidioidomycosis, Histoplasmosis                                                                                                                                                                                                                                   | 12            |
| IV   | <b>Opportunistic Mycoses:</b> Aspergillosis, Penicillosis, Zygomycosis (Mucormycosis, Phycomycosis) Candidiasis (Candidiasis, Moniliasis), Cryptococcosis (Torulosis), Pneumocystosis                                                                                                                                                                                    | 14            |
| V    | <b>Miscellaneous Mycoses:</b> Otomycosis, Oculomycosis (Keratomycosis, Fungal Keratitis, Mycotic Keratitis), Mycotic Poisoning                                                                                                                                                                                                                                           | 8             |
|      | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                             | <b>60</b>     |



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### Suggested Reading:

- Jagdish Chander – *Textbook of Medical Mycology*, Jaypee Brothers Medical Publishers
- George S. Fischer – *Fundamentals of Diagnostic Mycology*
- Fields Virology – Editors: David M. Knipe & Peter M. Howley, Published by Lippincott Williams & Wilkins
- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- Apurba Sankar Sastry & Sandhya Bhat K – *Essentials in Medical Microbiology*, Jaypee Brothers Medical Publishers
- Surinder Kumar – *Essentials of Microbiology*, Jaypee Brothers Medical Publishers
- J.G. Collee, A.G. Fraser, B.P. Marmion, A. Simmons – *Mackie & McCartney Practical Medical Microbiology*, Elsevier

### Course: Public Health Microbiology

**Total Credits: 4 (60 hours)**

**Course Rationale:** This course enables to equip students with an insight into antimicrobial Chemotherapy and incidence of antimicrobial resistance. This course also allows for an in-depth study of the principles and tools of epidemiology, infection dynamics, and how diseases spread in populations, enabling them to interpret disease patterns and outbreaks. It provides comprehensive insights into sources, types, transmission, and control measures for HCAs. It also introduces to biomedical waste management and highlights the nature of biological warfare.

### Learning Objectives:

- Evaluate criteria for the rational selection of antimicrobial drugs, including MIC and therapeutic index.
- Analyse how infections establish and progress through stages in the host.
- Recognise community-level significant infectious diseases and public health responses.
- Describe the role of epidemiologists in epidemic surveillance and control.
- Apply standard infection control precautions and preventive practices.
- Classify different types of biomedical waste.
- Discuss strategies for detection, prevention, and containment of bioterrorism-related infections.

| UNIT | M03MLSMM03<br>Public Health Microbiology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | C=4<br>(60hr) |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I    | <b>Antimicrobial Chemotherapy principles:</b><br>The origins of antimicrobial drugs, Interaction between drugs and microbes<br><b>Major antimicrobial drug groups:</b><br>Antibacterial drugs that act on the cell wall, antibiotics that damage bacterial cell membrane, Drugs that act on DNA and RNA, Drugs that interfere with protein synthesis, Drugs that block metabolic pathways<br><b>Drugs to treat Fungal, Parasitic and viral infections:</b><br>Antifungal drugs, Antiparasitic Chemotherapy<br><b>Interactions between microbes and drugs:</b><br>The acquisition of drug resistance | 12            |



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|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | <p>How does Drug resistance develop? Specific mechanisms of Drug resistance, Natural selection and Drug resistance</p> <p><b>Interactions between drugs and Hosts</b></p> <p>Toxicity to organs, Allergic responses to drugs, Suppression and Alteration of the microflora by antimicrobials</p> <p><b>Considerations in selecting an antimicrobial drug:</b></p> <p>Identifying the agent, testing for the susceptibility of microorganisms, The MIC and the therapeutic index, Patient factors in choosing an antimicrobial drug</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |
| <b>II</b>  | <p><b>Principles of Epidemiology</b></p> <p>The science of Epidemiology, The Vocabulary of Epidemiology, Disease reservoirs and Epidemics, Measuring Frequency: The Epidemiologist's Tools</p> <p><b>Major factors in the development of an infection:</b></p> <p>Phase 1: portals of entry</p> <p>Phase 2: Attachment to the Host</p> <p>Phase 3: Invading the Host and becoming established</p> <p><b>The Infectious Disease cycle: Recognition of an Infectious disease in a population:</b></p> <p>Remote sensing and Geographic Information Systems: Charting infectious diseases, correlation with a single causative agent, Recognition of an epidemic, Infectious disease transmission, The Host Community</p> <p><b>The outcomes of Infection and Disease:</b></p> <p>The stages of clinical infection, Patterns of infection, Signs and symptoms-warning signals of disease, the portal of exit-Vacating the Host, The persistence of microbes and pathologic conditions.</p> | <b>12</b> |
| <b>III</b> | <p><b>Measures of disease outbreaks:</b></p> <p>Procedures used in the investigation of infectious disease outbreaks, Outbreak investigation- team, role of microbiologist in the team, Laboratory diagnosis in public health</p> <p><b>Epidemiologically significant infectious diseases in the community</b></p> <p><b>The recent Epidemics:</b></p> <p>The HIV/AIDS Pandemic, Swine-flu-pandemic (H1N1) 2009 Influenza, SARS as a model of epidemiological success, The COVID pandemic, Healthcare associated infections</p> <p><b>Emerging and Reemerging Infectious diseases and pathogens:</b></p> <p>Reasons for increases in emerging and reemerging infectious diseases</p>                                                                                                                                                                                                                                                                                                    | <b>10</b> |
| <b>IV</b>  | <p><b>Epidemiology and Public Health:</b></p> <p>Public health measures for the control of disease, Global Health considerations</p> <p><b>Control of Epidemics:</b></p> <p>The role of the Public Health Systems: Epidemiological Guardian</p> <p>Global Travel and Health considerations: Space Travel</p> <p>Nosocomial Infections, The hospital Epidemiologist</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>6</b>  |
| <b>V</b>   | <p><b>Healthcare associated infections:</b></p> <p>Catheter associated UTI, Healthcare -associated bacteremia, Healthcare associated pneumonia and ventilator associated pneumonia, Healthcare</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>12</b> |



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|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | <p>associated wound infections (Surgical site infections) Healthcare associated infections due to Hepatitis viruses B and C (Transfusion-associated infections), Healthcare associated episodes of acute gastroenteritis, Healthcare associated episodes of tetanus</p> <p><b>Sources and reservoirs of healthcare associated infections:</b><br/>Endogenous sources of infection, Cross-infection, Infections from environmental sources</p> <p><b>Modes of transmission of microorganisms</b></p> <p><b>Measures to control infection in the healthcare setting:</b><br/>Standard precautions, Personal protective equipment, Safe injection practices, Environmental cleaning, medical equipment, Respiratory hygiene/Cough etiquette</p> <p><b>Precautions in the operating theatre</b><br/>Investigation and follow-up of outbreaks of disease<br/>Monitoring and regulation of HCAI: Hospital Infection Control Committee</p> |           |
| <b>VI</b>  | <p><b>Biomedical waste management</b><br/>Types of biomedical waste</p> <p><b>General principles of waste management:</b><br/>Reduction, Segregation, Storage, Transportation, Treatment</p> <p><b>Methods of waste management</b></p> <p><b>Waste treatment:</b><br/>Chemical disinfection, Deep burial, Incineration, Autoclaving, Microwaving, Inertisation</p> <p>Liquid waste disposal</p> <p><b>BMW 2016 Rules</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>4</b>  |
| <b>VII</b> | <p><b>Bioterrorism and disaster Management:</b><br/>Definition of bioterrorism, types of bioterrorism agent (CDC Classification), Biological warfare, Global incidents, Role of microorganism in bioterrorism, Emerging pathogen as potential bioweapons, detection, diagnosis, lab safety protocols, biosafety levels and containment.</p> <p>Phases of disaster management, bioterrorism preparedness and response – Surveillance, warning, emergency response, stockpiling of medicine, decontamination and Quarantine protocols. Use of PPE and infection control, mass casualty management.</p>                                                                                                                                                                                                                                                                                                                                | <b>4</b>  |
|            | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>60</b> |

**Suggested Reading:**

- Robert Friis, Thomas Sellers – *Epidemiology for Public Health Practice*, Jones & Bartlett Learning
- Prescott, Harley, Klein – *Microbiology*, McGraw-Hill Education
- Michael T. Madigan – *Brock Biology of Microorganisms*, Benjamin Cummings, Pearson Education
- R. Ananthanarayan & C.K. Jayaram Paniker – *Textbook of Microbiology*, Universities Press
- K Park – *Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publishers



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- Armed Forces Medical College (AFMC) – *Textbook of Public Health and Community Medicine*, AFMC & WHO India
- Leon Gordis – *Epidemiology*, Saunders, Elsevier
- Kenneth J Rothman – *Epidemiology: An Introduction*, Oxford University Press
- Robert B. Wallace – *Maxcy-Rosenau-Last Public Health and Preventive Medicine*, McGraw-Hill Education
- R Bonita, R Beaglehole, T Kjellstrom – *Basic Epidemiology*, World Health Organization, Geneva

**Course: Advances in Microbial Informatics**

**Total Credits :4 ( 60 hours)**

| UNIT       | <b>M03MLSMM04</b><br><b>Advances in Microbial Informatics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>C=4</b><br><b>(60hr)</b> |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <b>I</b>   | Microbial Informatics: Introduction to Bioinformatics, Information flow, Scope of Bioinformatics, computers and microbes, basics of internet, Network-based services (Cloud & Grid Computing), microbial informatics, environment and diversity                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>8</b>                    |
| <b>II</b>  | Microbial genomes and data platform: Basics of Database designing and modeling, Designing policies, File formats (FASTA, PIR, Genbank), data storage, retrieval, Microbial Genomes, Genbank, 5 Pfam, KEGG, Brenda, MBGD, biodiversity databases. String comparison, and Smith–Waterman algorithm, BLAST algorithm, FASTA algorithm comparison, Sequence submission tools (Banklt, Sequin).                                                                                                                                                                                                                                                                                   | <b>10</b>                   |
| <b>III</b> | Omics and Microbiome Informatics:<br>Types of omics in relation to microbiology.<br>Genomics and metagenomics - Gene structure, Gene finding strategies Glimmer, Genscan, promoter region identification, promoter signals, genome annotation tools, Gene ontology, biological networks;<br>Proteomics: Protein sequence and structures (primary, secondary and tertiary) and prediction, protparam, Chou– Fasman algorithm, GOR method, Concepts of structural modeling and tools PHD, ANOLEA, Transmembrane protein prediction tools, Mass spectrometry data and analysis;<br>Transcriptomics and Metabolomics<br>Multi-omics- integration of omics and microbial function | <b>14</b>                   |
| <b>IV</b>  | Phylogenetics and Evolutionary Informatics: Principles of Phylogeny analysis, Phylogenetic reconstruction distance matrix, types of trees, Rooted unrooted, distance-based methods (UPGMA, FM, NJ Methods), Character based methods (Parsimony method, Maximum likelihood method), tree evaluation, (bootstrapping, Jackknifing), functional inferences. Phylogenetic profiles and functional inference.                                                                                                                                                                                                                                                                     | <b>10</b>                   |
| <b>V</b>   | Diagnostic Informatics in Microbiology: Microscopy, Rapid antigen test, PCR, RFLP, Genome sequencing projects, next-generation sequencing generation (NGS), Computational tool and pipelines, microarray technology, data analysis                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>12</b>                   |



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|           |                                                                                                                                                                                                                                                                                                                                                                       |           |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | methods and tools; Applications in public health diagnostics and outbreak tracking.                                                                                                                                                                                                                                                                                   |           |
| <b>VI</b> | Antimicrobial Resistance & Comparative Genomics: Phenotypical and genotypical characterisations of resistance formation, application of NGS in studying the resistance mechanisms, mutations, AMR genes, and relevant genes. Comparison of ancestral microbe with mutant bacteria using bioinformatic tools; Ethical and regulatory perspectives in AMR data sharing. | <b>8</b>  |
|           | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                          | <b>60</b> |

#### Suggested Reading:

- Sandy B. Primrose, Richard Twyman – *Principles of Genome Analysis and Genomics*, Wiley-Blackwell
- P.B. Gupta – *Transcriptomics and Proteomics*, Elsevier
- Michael Hecker, Ian Humphery-Smith – *Microbial Proteomics: Functional Biology of Whole Organisms*, John Wiley & Sons,
- Alexander, *Microbial system biology*, Alexander, Springer

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|  | <b>M03MLSMM05</b><br><b>Medical Mycology &amp; Medical virology Practical</b> | <b>C=2</b><br><b>(60hr)</b> |
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#### Medical Mycology

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

#### Medical Virology

- **Biosafety Practices:** Spill management, PPE use, NSI protocols
- **Sample Collection & Handling:** Viral transport, documentation, cold-chain maintenance
- **Serological Testing:** ELISA, ICT for antigen/antibody detection
- **Molecular Diagnostics:** PCR workflow, primer setup, IFA for viral gene localisation
- **Virus Isolation (Demo/Simulation):** Cell culture, cytopathic effects observation



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- **Interpretation & Reporting:** Test result analysis in clinical/outbreak settings
- **Quality Assurance:** QA/QC protocols, recordkeeping, equipment calibration
- **Case Analysis:** Syndromic profiling, correlation with epidemiological findings

**\*Clinical laboratory rotation/observation can be incorporated wherever possible**

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|  | <b>M03MLSMM06</b><br><b>Public Health Microbiology Practical</b> | <b>C=2</b><br><b>(60hr)</b> |
|--|------------------------------------------------------------------|-----------------------------|

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

**\*Clinical laboratory rotation/observation can be incorporated wherever possible**

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|  | <b>M03MLSMM07</b><br><b>Clinical posting</b> | <b>C=2</b><br><b>(90hr)</b> |
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