

**List of Ph.D. Course work subjects that can be offered under
Microbiology Group from 2026**

Medical Microbiology							
Group I		Group II		Group III		Group IV	
Subject Code	Name of the subject	Subject Code	Name of the subject	Subject Code	Name of the subject	Subject Code	Name of the subject
PHMB101	Medical Microbiology	PHMB201	Clinical Bacteriology	PHMB301	-	PHMB401	Virology
PHMB102	Family Enterobacterice	PHMB202	Carbapenem Resistance	PHMB302	General Mycology	PHMB402	Medical virology -Arboviral diseases
PHMB103	Methods for Antifungal Susceptibility Testing	PHMB203	Systemic Bacteriology	PHMB303	General Microbiology	PHMB403	Non-Lactose Fermenting Bacteria
PHMB104	Medical Mycology	PHMB204	Fungal Genetics	PHMB304	Enterobacteriaceae	PHMB404	Cytogenetics

PHMB101: MEDICAL MICROBIOLOGY

Unit – 1

Structure & classification of Microorganisms and their properties, Sterilisation & Disinfection, Culture media and Methods, Identification of Microorganisms

Unit – 2

Infection caused by various Microorganisms, Immunity to infectious diseases, Properties of Antigen and Antibody, Antigen Antibody Reactions, Structure and functions of immune system, Immune responses

Unit – 3

Bacterial Genetics and Drug resistance power, Properties of antibiotics and its classification, Methods of antibiotic sensitivity test, Immunoprophylaxis by vaccines

Unit – 4

Gram Positive Cocci Bacteria, Gram Negative Cocci, Gram Positive Bacilli, Gram Negative Cocci, Structure & Properties of Viruses and fungi

Unit – 5

Normal flora of Human Body, Bacteriology of Water, Milk & Air, Hospital Infection, Immunoprophylaxis, CSST & HICC, Biomedical Waste Management

PHMB102: FAMILY ENTEROBACTERIACEAE

Unit 1- General Microbiology

Sterilization, Culture media and methods, Identification of micro-organism, Bacterial genetics, Bacterial drug resistance

Unit 2- Immunology

Immunity, Antigen and antibodies, Antigen and antibody reaction, Compliment system, Hypersensitivity

Unit 3- General Characteristics of Enterobacteriaceae

Introduction to Enterobacteriaceae family, Morphological features, Cultural characteristics, Biochemical properties, Laboratory diagnosis

Unit 4- Pathogenicity of Enterobacteriaceae

Escherichia coli (E. coli), Klebsiella, Proteus species, Enterobacter, Salmonella and Shigella

Unit 5: Laboratory Diagnosis, Treatment, and Infection Control

Specimen collection and processing, Culture methods and selective media, Biochemical identification tests, Antimicrobial susceptibility testing, Treatment

PHMB103: METHODS FOR ANTIFUNGAL SUSCEPTIBILITY

Unit I

Sample collection in Fungal infections: Methods of collection and transport to the laboratory.

Unit II

Methods for Antifungal susceptibility testing: Principle, procedure and method of testing

- Minimum Inhibitory Concentration
- E-Test Principle, media used and method of interpretation
- Vitek, Maldi-Tof, Bactec, Flow cytometry Principle and working of the instruments.
- PCR (Molecular methods) NAAT.

Unit III

Drug resistance in fungi. Agar dilution methods and broth dilution methods, newer methods of detection.

Unit IV

Fungal drug resistance linked to various virulence factors including biofilm production.

Unit V

Immunology of fungal infections: Innate immunity and adaptive immune responses, immunity in immunocompromised host, cytokines in fungal infections

Unit VI

List the class of antifungals. Classification of antifungals. Principle, mode of action

Unit VII

Monoclonal antibodies for the treatment of fungal infections.

PHMB104: MEDICAL MYCOLOGY

UNIT 1: Fundamentals of Medical Mycology

- **Introduction to Fungi**
 - General characteristics of medically important fungi
 - Morphology: yeasts, molds, dimorphic fungi
- **Taxonomy & Classification**
 - Classical vs molecular classification
 - Modern trends in fungal systematics
- **Fungal Reproduction**
 - Asexual and sexual reproduction
 - Spores and their medical significance

UNIT 2: Epidemiology and Diagnosis of Mycoses

- **Epidemiology of Fungal Infections**
 - Community-acquired infections
 - Nosocomial (hospital-acquired) infections
 - Risk factors (immunocompromised hosts)
- **Host-Fungus Interaction**
 - Tissue reactions to fungal infections
 - Immune responses (innate & adaptive)
- **Laboratory Diagnosis**
 - Microscopy (KOH mount, staining techniques)
 - Culture methods and identification
 - Serological tests
 - Molecular diagnosis (PCR-based detection of fungal DNA)

UNIT 3: Antifungal Therapy

- **Systemic Antifungal Drugs**
 - Polyenes, azoles, echinocandins
 - Mechanism of action and resistance
- **Topical Antifungal Agents**
 - Common formulations and uses
- **Antifungal Resistance**
 - Mechanisms and clinical challenges

UNIT 4: Superficial and Cutaneous Mycoses

- **Superficial Mycoses**
 - Pityriasis versicolor
 - Tinea nigra
 - Piedra
- **Cutaneous Mycoses (Dermatophytosis)**
 - Causative agents (dermatophytes)
 - Pathogenesis
 - Clinical features

- Laboratory diagnosis
- Treatment

UNIT 5: Subcutaneous Mycoses

- **Mycetoma**
- **Sporotrichosis**
- **Chromoblastomycosis**
- **Phaeohyphomycosis**
 - Etiology and morphology
 - Cultural characteristics
 - Pathogenesis
 - Clinical features
 - Laboratory diagnosis
 - Treatment

UNIT 6: Systemic (Endemic) Mycoses

- **Histoplasmosis**
- **Blastomycosis**
- **Coccidioidomycosis**
- **Paracoccidioidomycosis**
 - Causative agents
 - Pathogenesis
 - Clinical features
 - Laboratory diagnosis
 - Treatment

UNIT 7: Opportunistic Mycoses

- **Candidiasis**
- **Cryptococcosis**
- **Pneumocystosis**
- **Aspergillosis**
- **Mucormycosis**
 - Causative agents
 - Virulence factors
 - Pathogenesis
 - Clinical manifestations
 - Laboratory diagnosis
 - Treatment

UNIT 8: Advanced Topics in Medical Mycology

- **Molecular Medical Mycology:** PCR, sequencing, and fungal genomics in diagnosis
- **Antifungal Susceptibility Testing:** Methods and interpretation

PHMB201: CLINICAL BACTERIOLOGY

Unit – 1

Collection and identification of clinical samples for bacteriology

Various biochemical test used in bacteriology, Identification of Bacteria, Antibiotic sensitivity pattern of Bacteria, Drug resistance in bacteria

Unit – 2

Cardiovascular / Respiratory infection caused by Bacteria

Etiological agents rheumatic fever, Infective endocarditis, Anemia, Tuberculosis

Unit – 3

Gastrointestinal & Hepatobiliary infections

Diarrhoea & Dysentery, Enteric fever, Food Poisoning, PUO

Unit – 4

Skin, Soft tissue & CNS infection

Infection of Bone & Joints, Meningitis, Encephalitis, Skin and Soft tissue infections

Unit – 5

Zoonotic Diseases

Classification, Mode of Transmission, Prevention and control, Leptospirosis

Unit 1-Classification of antibiotic

Types of antibiotics, Different classes of antibiotics

Unit 2- Mechanisms of Drug resistance

Mutation, Conjugation, Transformation, Transduction

Unit 3: Introduction to Carbapenems and Resistance

Carbapenems: History, structure, and mechanism of action.

Importance of Carbapenems: Spectrum of activity and clinical significance.

Unit 4: Mechanisms of Carbapenem Resistance

Intrinsic vs Acquired Resistance.

Role of Beta-Lactamases: Class A (KPC), Class B (Metallo-beta-lactamases like NDM, VIM, IMP), and Class D (OXA-type).

Unit 5: Detection and Diagnosis of Carbapenem Resistance

- Phenotypic Methods:
- Modified Hodge Test (MHT).
- mCIM and eCIM test
- Genotypic Methods:
- PCR-based techniques.

PHMB203: SYSTEMIC BACTERIOLOGY

Unit 1

Pathogenic Staphylococcus, pathogenesis, laboratory diagnosis, antibiotic susceptibility test and MRSA (phenotypic and genotypic detection methods).

Unit 2

Importance of CONS in opportunistic infections MRCONS.

Unit 3

Healthcare associated infections Definition, types of Hospital acquired infections, detailed description of HAI, Laboratory diagnosis, treatment, prevention and bundle approach

Unit 4

Role of Carrier in transmission of infection. Types of carriers, classification, serological detection of carriers.

Unit 5

Drug resistance in Enterococci. Phenotypic and genotypic detection of drug resistance.

Unit 6

Enterobacteriaceae (Shigella, Salmonella, Vibrio, E. coli,), antigenic structure, morphology, virulence factors, laboratory diagnosis, serology antibiotic sensitivity, molecular methods used in the detection of drug resistance

Unit 7

Bacillus. Food poisoning, pathogenesis, laboratory diagnosis, treatment

Unit 8

Acinetobacter antigenic structure, morphology, virulence factors, laboratory diagnosis, serology antibiotic sensitivity, molecular methods used in the detection of drug resistance

Unit 9

Pseudomonas. antigenic structure, morphology, virulence factors, laboratory diagnosis, serology antibiotic sensitivity, molecular methods used in the detection of drug resistance

Unit 10

Stenotrophomonas antigenic structure, morphology, virulence factors, laboratory diagnosis, serology antibiotic sensitivity, molecular methods used in the detection of drug resistance

Unit 11

Burkholderia. antigenic structure, morphology, virulence factors, laboratory diagnosis, serology antibiotic sensitivity, molecular methods used in the detection of drug resistance

Unit 12

Miscellaneous bacteria. antigenic structure, morphology, virulence factors, laboratory diagnosis, serology antibiotic sensitivity, molecular methods used in the detection of drug resistance

Unit 13

Lab diagnosis of Bacterial Infections.

UNIT 1: Fungal Genome Organization and Diversity

Genome Structure: Organization of the fungal nucleus, mitochondria, and plasmids.

Diversity & Classification: Molecular taxonomy, modern trends in biosystematics, and phylogenetic analysis of fungi.

Chromosomal Structure: Numerical and structural alterations (ploidy, deletions, inversions, translocations) in fungi.

UNIT 2: Molecular Fungal Genetics

DNA Replication & Repair: Mechanisms of DNA replication and specialized repair pathways in fungi.

Gene Expression Regulation: Transcriptional, post-transcriptional, and epigenetic regulation (chromatin remodeling, methylation).

Parasexual Cycle: Mechanism and significance of the parasexual cycle in genetic mapping.

Mobile Genetic Elements: Transposons and their role in fungal genome evolution

UNIT 3: Fungal Transformation and Gene Manipulation

Genetic Engineering Tools: Vectors (plasmids, BACs), selectable markers, and reporter genes (GFP, GUS).

Transformation Techniques: Protoplast transformation, Agrobacterium-mediated transformation (AMT), and biolistics.

Gene Silencing & Knockout: RNA interference (RNAi), CRISPR-Cas9 genome editing, and homologous recombination techniques

UNIT 4: Functional Genomics and Bioinformatics

Functional Genomics: Transcriptomics (RNA-Seq), Proteomics, and Metabolomics to understand gene function.

Bioinformatics Tools: Genome database browsing, sequence alignment, phylogenetic tree construction, and metabolic pathway mapping.

UNIT 5: Applied Fungal Genetics

Host-Pathogen Interactions: Molecular basis of virulence, effector biology, and resistance mechanisms.

Industrial Genetics: Strain improvement, optimization of gene expression for enzyme/secondary metabolite production.

PHMB302: GENERAL MYCOLOGY

Unit 1

Sterilization & Disinfection

- Physical methods: Dry heat and moist heat, Filtration
- Chemical methods: Aldehydes, Alcohols, Halogens. Dyes, Surface active agents, Gases
- Sterilization controls
- Radiation: Ionising and non-ionising radiation
- ETO and others

Unit 2

Conventional Mycological Technique

- BOD incubator: Principle, working and uses
- Biosafety cabinet Levels I, II, III: Principle, working and uses
- Culture Media used for growth of fungus
- Staining Techniques Principle, mechanism and Procedure

Unit 3

Classification of Fungi

Unit 4

Sugar fermentation & Sugar assimilation test including other biochemical tests.

Unit 5

Lab diagnosis of Fungal Infections. Direct microscopy, antigen detection, culture methods used, other tests to demonstrate the different characteristics of fungus

Unit 6

Serological Diagnosis of fungal infections.

Unit 7

Opportunistic fungal infections.

Unit 8

Probiotics & Pre-biotics.

Unit 9

Importance of fungus in food industry.

Unit 10

Role of commensal fungi in Health. Gut microbiota

Unit 11

Importance of Fungus in Genetic Engineering.

PHMB303: GENERAL MICROBIOLOGY

Unit I: Introduction to Microbiology

1. History and scope of microbiology
2. Major groups of microorganisms: bacteria, viruses, fungi, algae, protozoa
3. Microbial diversity and classification
4. Prokaryotic vs eukaryotic microorganisms
5. Microbial growth and nutrition

Unit II: Basics of Research Methodology

1. Definition and objectives of research
2. Types of research: basic, applied, exploratory, descriptive, experimental
3. Scientific method and hypothesis formulation
4. Research design and planning
5. Variables, controls, and replication

Unit III: Laboratory Safety and Good Laboratory Practices (GLP)

1. Biosafety levels (BSL I–IV)
2. Laboratory safety rules and waste disposal
3. Sterilization and disinfection methods
4. Aseptic techniques
5. Ethical issues in microbiological research

Unit IV: Microbiological Techniques

1. Microscopy: bright field, phase contrast, fluorescence, electron microscopy
2. Staining techniques: simple, differential (Gram, acid-fast), special stains
3. Culture techniques: pure culture, enrichment culture
4. Isolation and identification of microorganisms
5. Enumeration methods (viable count, total count)

Unit V: Experimental Design in Microbiology

1.Sampling methods

2.Media preparation and

3.Troubleshooting experimental errors

4.Reproducibility and validation

Introduction to Enterobacteriaceae

- Definition, General characteristics & cell structure
- Classification and taxonomy
- Morphology & Growth requirements

Important Genera of Enterobacteriaceae

- Escherichia
- Salmonella
- Shigella
- Klebsiella
- Enterobacter
- Proteus
- Citrobacter
- Yersinia

Identification

- Staining and cultural characteristics
- Antigenic components (O, H, and K antigens)
- Biochemical identification tests
- Serological identification
- Automated identification systems

Pathogenesis (virulence factors) and Diseases

- Mechanisms of pathogenicity
- Toxins and adhesion factors
- Gastrointestinal infections
- Urinary tract infections
- Septicemia and systemic infections
- Hospital-acquired infections

Antimicrobial Resistance

- Mechanisms of resistance
- Extended spectrum beta lactamases (ESBL)
- Carbapenem resistance
- Multidrug-resistant Enterobacteriaceae
- Surveillance and control

Lab diagnosis, Treatment & Prevention

- Specimen collection & Transport
- Conventional microbiological methods
- Automated identification systems
- Molecular diagnostic techniques (PCR, sequencing)
- Infection control practices
- Antibiotic stewardship
- Vaccination strategies (where applicable)
- Public health measures

Unit I: General and Molecular Virology

Nature and structure of viruses, symmetry, envelopes, viral genomes. Viral taxonomy (ICTV principles), classification of medically important viruses. Steps of viral replication: attachment, penetration, uncoating, replication, assembly, release. Replication strategies of DNA viruses, positive- and negative-sense RNA viruses, segmented genomes, reverse-transcribing viruses. Viral genetics: mutation, reassortment, recombination, quasispecies, defective interfering particles. Viral evolution, emergence and re-emergence, zoonotic spillover.

Unit II: Virus-Host Interaction and Pathogenesis

Mechanisms of viral pathogenesis: cell tropism, cytopathic effect, oncogenesis, immune evasion. Innate and adaptive immune responses to viral infection (interferons, NK cells, T cells, antibodies). Persistent, latent, slow, and chronic infections. Immunopathology in viral diseases (e.g. immunopathology in hepatitis, dengue, COVID-19). Viral oncogenesis: oncogenic DNA and RNA viruses, mechanisms, examples.

Unit III: System-wise Medical Virology

For each group, include: important viruses, pathogenesis, clinical features, lab diagnosis, prevention and control. Herpesviridae (Herpes Simplex, Cytomegalovirus, Epstein-Barr, Varicella-Zoster), Papillomaviridae (HPV), Poxviridae (Molluscum Contagiosum, Mpox), Adenoviridae, Hepadnaviridae (Hepatitis B), and Polyomaviridae (Merkel Cell Polyomavirus), Hepatotropic viruses: with emphasis on HBV- molecular biology, chronic infection, carcinogenesis.

Unit IV: Diagnostic and Research Virology

Specimen collection, transport and storage for viral diagnosis; biosafety levels (BSL-2/BSL-3), infection control. Classical diagnostic methods: Virus isolation in cell culture, embryonated eggs, animals (principles and indications) Cytopathic effect, haemadsorption, neutralization, haemagglutination inhibition Serology in virology: ELISA, CLIA, rapid tests, avidity, paired sera, interpretation and limitations. Molecular diagnostics: Conventional and real-time PCR, RT-PCR, nested PCR, multiplex assays Viral load estimation, genotyping, sequencing basics Emerging methods: digital PCR, isothermal amplification (LAMP, RPA), point-of care molecular tests, Viral genomics and bioinformatics basics: genome organization, sequence analysis, phylogeny overview. Quality assurance, external quality assessment (EQA), validation and accreditation concepts.

Unit V: Prevention, Control and Therapeutics

Antiviral agents: classes, mechanisms of action, resistance, clinical indications, toxicity overview (e.g. nucleoside analogues, protease inhibitors, integrase inhibitors, neuraminidase inhibitors, direct-acting antivirals for HCV)..Infection control and hospital infection surveillance for important viral pathogens (HBV, HCV, HIV, influenza, SARS-CoV-2, viral haemorrhagic fevers).Public health virology: outbreak investigation steps, basic epidemiological measures, surveillance systems.

UNIT 1: General Overview – Dengue and Other Arboviruses

Definition, classification and General properties of arboviruses like Dengue, Chikungunya & JE. Dengue virus: structure, classification (DENV-1 to 4), genome, antigenic structure, replication and cultivation.

UNIT 2: Vector Biology – Dengue, Chikungunya &JE

Vector biology, transmission cycle, virus–host interactions, immunity and pathogenesis; risk factors for severe Dengue.

UNIT 3: Clinical Syndromes & Epidemiology – Dengue, Chikungunya & JE

History and epidemiology of Dengue: Global, Indian and Karnataka scenario; clinical classification, course and complications. Overview of Chikungunya, JE, basic Epidemiology and clinical syndromes. Integration of laboratory data with clinical features and public health actions (outbreak investigation, risk mapping)

UNIT 4: Methods and Techniques for Arboviral Diagnosis and Research

Pre-analytical aspects: sample collection, transport and storage for suspected Dengue/Arboviral infections. Serological diagnosis: principles and applications of ELISA for Dengue and Chikungunya &JE IgM/IgG interpretation& NS1 antigen testing. Molecular diagnosis: RT-PCR for Dengue and Chikungunya &JE Serotyping and genotyping of Dengue virus; Whole Genome Sequencing (WGS) for molecular typing and surveillance.

UNIT 5: Treatment and Clinical Management

Symptomatic treatment & Fluid management in dengue. Management of joint pain in chikungunya. WHO treatment guidelines

UNIT 5: Prevention & Control

Preventive measures like vaccines for Dengue& JE, status of Chikungunya vaccines, Xenomonitoring and surveillance. Vector control strategies, Community awareness programs & Personal protection methods

PHMB403: NON-LACTOSE FERMENTING BACTERIA

UNIT 1- Introduction to Non-Lactose Fermenting Bacteria

- Definition and Characteristics
- Examples of Non-Lactose Fermenting Bacteria
- Overview of Gram-negative bacterial cell wall structure.

UNIT2- Specific Pathogens:

- Detailed study of *Pseudomonas aeruginosa*, *Burkholderia cepacia*, *Acinetobacter baumannii*, *Stenotrophomonas maltophilia*, *Elizabethkingae*.
- Clinical significance of each species and their role in various infections.
- Opportunistic infections in immunocompromised individuals.

UNIT 3- Pathogenicity Mechanisms:

- Mechanisms of bacterial adhesion, invasion, and colonization.
- Production of toxins and virulence factors.
- Role of biofilms in infection.

UNIT 4- Laboratory Diagnosis of Non-Lactose fermenting bacteria

UNIT 5- Antibiotic Resistance:

- Mechanisms of antibiotic resistance in non-lactose fermenters.
- Detection of antibiotic resistance

UNIT 6- Role of NFGNB in Health care Associated Infections.