

JSS Academy of Higher Education & Research

(Deemed to be University)

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Sri Shivarathreeshwara Nagara Mysuru - 570015, Karnataka

Regulation & Syllabus

MD MICROBIOLOGY

2020

MD MICROBIOLOGY

GOAL: The goal of postgraduate training in Microbiology is to produce a competent Clinical Microbiologist enriched with necessary knowledge, skills and attitude to impart education, to carry out fundamental and applied research and participate in good patient care and prevention of infectious diseases.

PREAMBLE:

The aim of postgraduate education in Microbiology is to impart requisite clinical, diagnostic, teaching and research skills with appropriate attitude and communication competencies required in the field of Medical Microbiology.

Currently the postgraduate students of Microbiology are trained in the laboratory with minimal exposure to patient care, but with technological advances and automation in diagnostic microbiology and increasing threat of infections due to emerging & reemerging microbes, drug resistance and widening host range, the training program of MD Microbiology is shifted from laboratory to clinical setting so as to contribute in the clinical management along with diagnosis, prevention and control of infectious disease.

This document provides guidelines to standardize Microbiology teaching at the postgraduate level and fulfill the expectations as a microbiologist. This curriculum guide gives more emphasis on training in patient care setting with integration of concepts of microbiology in various clinical specialties through dedicated postings, ward rounds, case discussion etc. This document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document has been prepared in concordance with National Medical Commission guidelines.

PROGRAM OUTCOMES:

PO1: Demonstrate the competence as a Clinical Microbiologist and acquire various skills for conducting operational and translational research in the field of Microbiology and basic sciences

PO2: Demonstrate the acquisition of comprehensive theoretical knowledge of medical microbiology including the spread of microorganisms, disease causation, and diagnosis of pathogens of major significance to public health and advanced practical training in this diverse field.

PO3: Demonstrate competency to establish good basic and advanced services in the microbiological fields such as bacteriology, virology, parasitology, mycology and immunology for diagnosis, patient management and Outbreak investigation.

PO4: Competent to demonstrate the advanced technical skills, apply problem solving techniques in identification and correction of pre analytical, post analytical and analytical errors with appropriate root cause analysis.

PO5: Competent to perform Quality control and Quality assurance in diagnostic microbiology and develop required knowledge/ skills towards accreditation of labs.

PO6: Competent to play a pivotal role in Hospital infection control practices and Antibiotic Stewardship.

PO7: Demonstrate the acquisition of comprehensive knowledge and communication skills required for the practice of clinical microbiology and for teaching undergraduate and postgraduate students.

PO8: Uphold the prestige of the discipline amongst health care professionals maintaining professional and ethical values.

PO9: Ability to upgrade knowledge and skills to be a life long learner

COURSE OUTCOMES:

Paper I – General Microbiology and Immunology (GM & IG)

At the end of the course, the students should be able to

CO1: Demonstrate the comprehensive knowledge on morphology, growth requirements and Host-microbe relationship of bacteria, viruses, parasites and fungi of medical importance.

CO2: Demonstrate knowledge and skills in various basic and advanced techniques for isolation and

identification of micro-organisms of medical importance

CO3: Understand the mechanisms of antimicrobial drug resistance and their detection methods

CO4: Demonstrate the comprehensive knowledge on various types of Sterilization and disinfection techniques and their applications

CO5: Describe components of immune system, types of immunity (Innate, acquired, mucosal, humoral and cell mediated immunity) and immune response in health and disease

CO6: Understand the types and applications of antigen - antibody reactions.

Paper II- Clinical/Systemic Microbiology (CM I)

CO1: Demonstrate the acquisition of comprehensive knowledge of etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines of infective syndromes of CVS and blood, Respiratory Tract Infections, and Central Nervous System infections.

CO2: Demonstrate the acquisition of comprehensive knowledge of etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines of infective syndromes of Urinary Tract Infections, Reproductive Tract Infections, Gastrointestinal Tract infections, and Hepatobiliary System.

CO3: Demonstrate the acquisition of comprehensive knowledge of etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines of infective syndromes of Skin and Soft tissue infections, Musculoskeletal system, infections of Eye, Ear and Nose etc

CO4: Perform and interpret the basic / advanced techniques in the identification of various micro-organisms causing the infective syndromes of various organs and systems of human body.

Paper III- Clinical/Systemic Microbiology (CM II)

CO1: Demonstrate the acquisition of comprehensive knowledge of etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines of Infectious diseases as per the source/risk such as Blood borne, sexually transmitted infections, congenital, vector borne, food, air & water borne, zoonotic, laboratory acquired, occupational infections etc.

CO2: Demonstrate the acquisition of comprehensive knowledge of etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines of Opportunistic infections in special and high risk host such as Pregnancy, neonates, geriatrics, diabetics, immunocompromised host due to any reason, patients with Implants/Devices, dialysis etc.

CO3: Demonstrate the acquisition of comprehensive knowledge of etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines of Infections in special situations / scenario such as Tropical, Travel related, Emerging/ Remerging Infectious diseases seen commonly, agents of bioterrorism etc.

CO4: Capability to elicit relevant history, interpret laboratory results with clinico-microbiological correlation and develop diagnostic and treatment algorithms.

Paper IV – Recent Advances & Applied Microbiology (AM)

CO1: Demonstrate the capability to apply knowledge and comprehension on general, immuno and chemoprophylaxis including vaccinology

CO2: Demonstrate the capability in application of knowledge in Hospital infection control practices and Antibiotic Stewardship program.

CO3: Demonstrate the comprehensive knowledge and skills on detection and reporting of drug resistance to antimicrobials.

CO4: Capability to apply the knowledge of automation, molecular techniques, information technology and statistical analysis in the field of diagnostic microbiology.

SUBJECT SPECIFIC OBJECTIVES

A postgraduate student upon successfully qualifying in the MD Microbiology examination should be able to:

1. Demonstrate competence in clinical aspects as a Microbiologist to improve patient care.
2. Demonstrate application of microbiology in different clinical settings to address diagnostic and therapeutic problems along with preventive measures.
3. Play an important role in hospital infection control by actively participating in activities

of the Hospital Infection Control Committee as a team member and management of biomedical waste.

4. Demonstrate competence in recording, advising and guiding use of antimicrobials judiciously for infectious diseases in routine and in special clinical situations and population.
5. Demonstrate competence in developing guideline for antibiotic usage, including formulation of antibiotic policy in hospital.
6. Demonstrate communication skills required for safe & effective laboratory practice and teaching of microbiology
7. Demonstrate skills in conducting collaborative research in the field of Clinical Microbiology and allied sciences which has significant bearing on human health and patient care.
8. Demonstrate ability to plan, execute and evaluate teaching and training assignments efficiently and effectively in Microbiology for undergraduate students as per Competency Based Medical Education (CBME).
9. Identify public health epidemiology, global health patterns of infectious diseases and effectively participate in community outreach and public health programs for investigation, prevention and control of infectious diseases.
10. Demonstrate ability to work as a member of the rapid response team and contribute to investigations of outbreaks of infectious diseases in the hospital and outbreak/epidemic/pandemic in the community.
11. Demonstrate self-directed learning skills and keep updated with recent advances in the field of clinical microbiology.
12. Demonstrate administrative and organizational skills to establish good clinical microbiological services in a hospital and in the community in the field of clinical microbiology
13. Demonstrate effective leadership and teamwork skills while working with other members of the health care team in hospital, laboratory and community settings.
14. Demonstrate attributes of professional behavior and uphold the prestige of the discipline amongst the fraternity of doctors.

Postgraduate training

The postgraduate training includes the following components for a holistic approach-

1. Clinical Microbiology including Antimicrobial Resistance (AMR)
2. Laboratory skills in diagnostic Microbiology
3. Infection Prevention and Control Skills
4. Teaching and learning Skills
5. Research Skills
6. Attitude, Ethics and Communication skills

The postgraduate student should develop and demonstrate competence in the above components as follows:

1. Clinical Microbiology including Antimicrobial Resistance (AMR)

- i. Should be able to elicit relevant history for optimum clinico-microbiological correlation with laboratory results.
- ii. Should be able to perform basic physical examination and assess the patients with any suspected infection including community acquired/ tropical infection/ sepsis/ imported infection/ hospital acquired infections and emerging and re-emerging infections.
- iii. Should be able to formulate and critique diagnostic algorithms and patient care plans.
- iv. Should be able to choose, interpret and communicate the results of appropriate microbiological investigation in a suspected infection.
- v. Should be able to suggest optimal antimicrobial therapy, based on results of antimicrobial susceptibility tests and other investigations.
- vi. Should be able to advocate antibiotic stewardship for prevention and control of AMR (detailed competencies under AMR are given in Annexure I),
- vii. Should be able to educate patients/ relatives/ community on various aspects of antimicrobial use, antimicrobial drug resistance, prevention and control of infections.

2. Laboratory skills in diagnostic Microbiology

- i. Should be able to demonstrate acquisition of pre-analytical, analytical and post-analytical laboratory skills to ensure quality of test results.
- ii. Should be able to perform tests pertaining to basic, diagnostic, clinical and applied Microbiology.

3. Infection Prevention and Control

- i. Should be able to demonstrate knowledge, skills & attitude required to detect, prevent and control health care associated infections of all types.
- ii. Should be able to set up and manage Central Sterile Services Department (CSSD) and prepare effective sterilization and disinfection policy for the hospital.
- iii. Should be able to demonstrate knowledge and skills about management of biomedical waste in health care setting as per recent guidelines and educate staff about risks, preventive measures and the management of occupational exposure to infectious agents.

4. Teaching and Learning Skills

- i. The Medical Education Department/Unit of the institution should be able to sensitize the postgraduate students in basic concepts of medical education technologies like domains of learning, teaching skills, teaching - learning methods, lesson planning, learning resource material, assessment techniques etc.
- ii. Should be able to demonstrate good teaching skills while conducting teaching/training sessions like tutorials, demonstrations and practical for undergraduate students, laboratory technicians etc. and participate actively in the planning and conduct of assessment of students learning at various stages of formative / summative assessment.
- iii. Should be able to learn by integrating with concerned subspecialty.

5. Research Skills

- i. Should be able to plan, design and conduct meaningful scientific research in microbiology in collaboration with allied subjects.
- ii. Should acquire expertise to write research protocol, thesis and present a research paper in the scientific forum.
- iii. Should follow guidelines on ethical conduct in research.
- iv. Should acquire proficiency and demonstrate ability to use biostatistics, data management.
- v. Should be able to critically appraise a scientific article and have knowledge of evidence-based practice.
- vi. Should acquire expertise in writing proposals for research grants and know the various sources of research funding.

6. Communication and attitudinal skills

- i. Should demonstrate the right kind of attitude, communication and ethics while dealing with clinical material and reports.
- ii. Should be able to work as an effective team member and leader.

SUBJECT SPECIFIC COMPETENCIES

The Post-Graduate student during the training programme should acquire the following predominant domain specific competencies to achieve the defined goals:

A) Cognitive Domain (Knowledge):

At the end of the course, the student should have acquired knowledge in the following competencies:

Paper I: General Microbiology (GM) & Immunology (IG)

General Microbiology (GM):

- i. Describe important historical events and developments in microbiology
- ii. Describe nomenclature, classification, morphology, growth requirements, pathogenesis and laboratory diagnosis of different bacteria, viruses, parasites and

- fungi.
- iii. Explain the importance of normal flora microbes, including Microbiome in health and disease.
 - iv. Explain the factors influencing and significance of microbial environment in health care setup.
 - v. Describe the epidemiology of common infectious diseases, host-parasite relationship and their significance.
 - vi. Describe various types of microscopes and microscopic techniques used in diagnostic microbiology.
 - vii. Explain various methods of isolation, identification and preservation of microbes in laboratory.
 - viii. Explain the type, mechanism of action and applications of microbial toxins, other virulence factors & microbial products like Bacteriocins.
 - ix. Explain the concept & application of various biosafety and biosecurity issues in laboratory and patient care including physical, biological containment and standard precautions.
 - x. Discuss the various methods of sterilization and disinfection and apply them in the laboratory and in patient care including testing of disinfectants.
 - xi. Explain the basic principles of bacterial genetics and applications of molecular techniques in medical microbiology.
 - xii. Explain the concept of microbiological surveillance including patient screening methods, organism typing and genome sequencing methodologies.
 - xiii. Explain the concept and application of quality assurance, quality control and accreditation in diagnostic microbiology.
 - xiv. Describe the significance and causes/reasons regarding emerging infectious diseases with strategies for their identification and control.
 - xv. Explain the concept and application of molecular biology techniques in the laboratory diagnosis of infectious diseases.
 - xvi. Explain the concept and use of information technology (LIS, WHO NET etc.) in microbiology laboratory effectively.
 - xvii. Describe the principles & implementation of animal and human ethics involved in

diagnostics and research in Microbiology

- xviii. Explain the principles and application of recent technological advances, automation, and application of Artificial Intelligence, nanotechnology, biosensors, bioinformatics, etc. in diagnosis & research in Microbiology.
- xix. Explain the importance and methods of testing microbiology of air, water and food in patient care both in community/ hospital setting.
- xx. Explain in detail about types & mechanism of action of Antimicrobial agents, their pharmacokinetics & pharmacodynamics, along with mechanism of drug resistance.
- xxi. Describe types and applications of Bacteriophages in diagnostic and therapeutic of infections

Immunology (IG)

- i. Describe the structure and function of the immune system, immunological mechanisms in health and response of the host immune system to infections. (Innate and acquired immunity, Cells involved in immune response, Antigens , Immunoglobulins, Mucosal immunity, Cell mediated immunity, Cytokines, MHC complex, Immune tolerance etc)
- ii. Explain the complement system and describe its role in health and disease.
- iii. Describe the mechanism/s in immunological disorders (hypersensitivity, autoimmune disorders and immunodeficiency states) and discuss the laboratory methods used in their diagnosis including measurement of immunological parameters
- iv. Describe the types & principles of antigen and antibody reactions and immunological techniques used in diagnostic microbiology as well as in research.
- v. Describe the immunological mechanisms of transplantation and tumor immunity.
- vi. Describe the mechanism/s and significance of immune-potentiation and immune-modulation.
- vii. Describe various types, techniques and advances in the development and applications of vaccines including UIP and immunotherapy and reverse vaccinology.
- viii. Explain the role of animals in immunology.

PAPER II Clinical / Systemic Microbiology –I (CM –I)

- i. Discuss in depth about the etiological agents, source, transmission, host-parasite

interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines in the situations/ scenario given below:

- **Infections of various organs and systems of the human body**

Microbiological basis of infective syndromes of various organs and systems of human body viz. CVS and blood, Respiratory Tract Infections, Urinary Tract Infections, Central Nervous System infections, Reproductive Tract Infections, Gastrointestinal Tract infections, Hepatobiliary System, Skin and Soft tissue infections, Musculoskeletal system, infections of Eye, Ear and Nose etc)

PAPER III: Clinical / Systemic Microbiology – II (CM-II)

- i. Discuss in depth about the etiological agents, source, transmission, host-parasite interaction, clinical manifestations, laboratory diagnosis, treatment, prevention, epidemiology, national, international guidelines in the situations/ scenario given below:

- **Infectious diseases as per the source/risk**
- **Opportunistic Infections** in special and high risk host
- **Infections in special situations/ scenario.**

Microbiological basis of infective syndromes as per the source/risk e.g. Blood borne, sexually transmitted infections, congenital, vector borne, food, air & water borne, zoonotic, laboratory acquired, occupational infections etc. Opportunistic Infections in special and high risk host eg Pregnancy, neonates, geriatrics, diabetics, immunocompromised host due to any reason, patients with Implants/Devices, dialysis etc, Infections in special situations/ scenario -Tropical, Travel related, Emerging/ Remerging Infectious diseases seen commonly, agents of bioterrorism etc.

- ii. Elicit relevant history, interpret laboratory results with clinico-microbiological correlation and develop diagnostic and treatment algorithms.

Following organisms (bacteria, fungi, virus and parasites) must be covered under clinical/systemic microbiology and the list updated to include newly identified microbes from time to time

Bacteria:

1. Gram positive cocci of medical importance including *Staphylococcus*, *Micrococcus*, *Streptococcus*, *anaerobic cocci* etc.
2. Gram negative cocci of medical importance including *Neisseria*, *Branhamella*, *Moraxella* etc.
3. Gram positive bacilli of medical importance including *Lactobacillus*, *Coryneform organisms*, *Bacillus* and *aerobic bacilli*, *Actinomyces*, *Nocardia*, *Actinobacillus* and *other actinomycetales*, *Erysipelothrix*, *Listeria*, *Clostridium* and other spore bearing anaerobic bacilli etc.
4. Gram negative bacilli of medical importance including *Enterobacteriaceae*, *Vibrios*, *Aeromonas*, *Plesiomonas*, *Haemophilus*, *Bordetella*, *Brucella*, *Gardnerella*, *Pseudomonas* and other non-fermenters, *Pasteurella*, *Francisella*, *Bacteroides*, *Fusobacterium*, *Leptotrichia* and other anaerobic gram negative bacilli etc.
5. *Helicobacter*, *Campylobacter*, *Calymmatobacterium*, *Streptobacillus*, *Spirillum* and miscellaneous bacteria
6. *Mycobacteria*
7. *Spirochaetes*
8. *Chlamydia*
9. *Mycoplasmatales*; *Mycoplasma*, *Ureaplasma*, *Acholeplasma* and other *Mycoplasmas*.
10. *Rickettsiae*, *Coxiella*, *Bartonella* etc.
11. Any newly emerging bacteria

Fungi:

1. Yeasts and yeast like fungi of medical importance including *Candida*, *Cryptococcus*, *Malassezia*, *Trichosporon*, *Geotrichum*, *Saccharomyces* etc.
2. Mycelial fungi of medical importance including *Dermatophytes*, *Aspergillus*, *Zygomycetes*, *Pseudallescheria*, *Fusarium*, *Piedra*, *other dematiaceous hyphomycetes* and *other hyalohyphomycetes* etc.
3. Dimorphic fungi including *Histoplasma*, *Blastomyces*, *Coccidioides*, *Paracoccidioides*, *Sporothrix*, *Talaromyces marneffe* etc.

4. Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis Otomycosis, Phaeohyphomycosis etc
5. *Pythium insidiosum*
6. *Prototheca*
7. *Pneumocystis jirovecii*
8. *Lacazia loboi* (*Loboa loboi*)
9. Laboratory contaminant fungi
10. Fungi causing Mycetism and mycotoxicosis
11. Any newly emerging fungi

Virus:

1. DNA viruses of medical importance including *Pox viruses*, *Herpes viruses*, *Adeno viruses*, *Hepadna virus*, *Papova* and *Parvo viruses* etc.
2. RNA viruses of medical importance including *Picorna viruses*, *Toga viruses*, *Flavi viruses*, *Orthomyxo viruses*, *Paramyxo viruses*, *Reo viruses*, *Rhabdo viruses*, *Arena viruses*, *Bunya viruses*, *Retro viruses*, *Filo viruses*, *Human immunodeficiency virus*, *Arbo viruses*, *Corona viruses*, *Calci viruses* etc.
3. Oncogenic viruses
4. Bacteriophages
5. Slow viruses including prions
6. Unclassified viruses
7. Viriods
8. Any newly emerging virus

Parasite:

1. Protozoan parasites of medical importance including *Entamoeba*, *Free living amoebae*, *Giardia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Toxoplasma*, *Sarcocystis*, *Cryptosporidium*, *Cyclospora* *Isospora*, *Babesia*, *Balantidium*, etc.
2. Helminths of medical importance including those belonging to Cestoda (*Diphyllobothrium*, *Taenia*, *Echinococcus*, *Hymenolepis*, *Dipylidium*, *Multiceps* etc.), Trematoda (*Schistosomes*, *Fasciola*, *Fasciolopsis*, *Gastrodiscoides*, *Paragonimus*, *Clonorchis*, *Opisthorchis* etc.) and Nematoda (*Ascaris lumbricoides*, *Ancylostoma*

duodenale, *Enterobius vermicularis*, *Trichuris trichiura*, *Filarial worms*, *Toxocara*, *Dracunculus* etc.)

3. *Rhinosporidium seeberi*
4. Entomology: common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myiasis etc.
5. Neglected tropical parasitic diseases
6. Any newly emerging parasite

Paper IV: Applied Microbiology (AM) & Recent Advances:

Student should be able to apply knowledge & comprehension about following applied aspects:

- i. **Prophylaxis** - Basic Principles and applications of general, immuno as well as chemo- prophylaxis of infections in various clinical situations / scenarios.
- ii. **Vaccinology**: types of vaccines, principles, methods of preparation of vaccines and administration of vaccines.
- iii. **Health care associated Infections** - types, pathogenesis, diagnosis, prevention, control and surveillance of health care associated infections.
- iv. Biomedical waste and its management.
- v. **Role of microbes in non-communicable diseases** - infectious agents in origin and progression of non-communicable diseases like cancer, diabetes, musculoskeletal disorder and influence of these microbes on mental health.
- vi. **Antimicrobial Resistance Detection and Prevention**: classification, mechanism of action, detection and reporting drug resistance to antimicrobials (antibacterial, antiviral, antifungal, antimycobacterial and antiparasitic agents).
- vii. Antimicrobial Stewardship Program
- viii. Investigation of an infectious disease outbreak in hospital and outbreak/epidemic/pandemic in community.
- ix. Information technology (computers) in microbiology.
- x. Automation in Microbiology.

- xi. Molecular techniques in the laboratory diagnosis of infectious diseases.
- xii. Statistical analysis of microbiological data and research methodology.
- xiii. Animal and human ethics involved in microbiological work.
- xiv. Laboratory safety and management.

B. Affective Domain

- iiix. Communicate effectively & empathically with patients and their relatives during sample collection, history taking, counseling and reporting results.
- iiix. Acquire Consent taking and counseling skills and demonstrate these to undergraduates.
- ivx. Communicate effectively with peers, and consultants for better clinical correlation of laboratory findings as well as research.
- vx. Demonstrate effective communication and attitudinal skill while teaching undergraduate students.
- vix. Function as an effective team member and leader with good conflict management skills.
- viix. Adopt ethical principles, particularly maintenance of confidentiality when dealing with laboratory reports.
- viiiix. Demonstrate ability to recognize and manage ethical and professional conflicts and abide by prescribed ethical and legal codes of conduct and practice.
- ixx. Demonstrate altruistic professional behavior with respect, discipline, responsibility, accountability, punctuality and integrity at all times while dealing with patients and their relatives.

C. Psychomotor Domain: (Skills)

C1. The postgraduate student should be able to perform the following and/or interpret the results independently or as a part of a team (**Certifiable skills**):

➤ **Laboratory skills:**

- Collect, transport and store appropriate specimens for microbiological

investigations.

- Receive and process clinical specimens after appropriate preparation of samples for the appropriate investigation (centrifugation, extraction, mincing, concentration etc.)
- Processing of samples by various methods like:
 - Macroscopic/gross examination of samples.
 - Choose the most appropriate microscopic method for demonstration of pathogens.
 - Prepare, examine, and demonstrate microbes in direct smears for diagnosis of infectious disease/s.
 - Isolate and identify pathogenic microbe from clinical specimens (by conventional & automated methods).
 - Perform, interpret & record antimicrobial susceptibility testing of the isolate.
 - Perform rapid, conventional and automated serological techniques for diagnosis of infectious diseases and immunological diseases.
- Maintain records and ensure quality control in microbiology.
- Maintain and preserve microbial cultures.
- Operate and maintain instruments used in the laboratory for sterilization and disinfection and patient care with quality control.
- Operate and maintain common laboratory equipment like microscopes, water bath, centrifuge, incubator, automated culture system, micro-centrifuge, ELISA washer and reader etc.
- Perform and assess significance of microbial contamination of food, water and air.
- Biosafety measures - biosafety cabinets, chemical material safety data sheet (MSDS), fire safety, needle stick injury management.

Organisms (Bacteria, Fungi, Virus and Parasites) based Laboratory skills:

- **Direct microscopic methods for demonstration of infectious agents:**
 - a. Wet mount examination for - looking for cells and organisms (bacteria, fungi, parasite)
 - i. Saline mount stool sample - parasitic morphology

- ii. Iodine mount-parasitic morphology
 - iii. KOH for fungi
 - iv. Negative staining
- b. Staining methods
 - i. Preparation of stains & quality check
 - ii. Preparation of peripheral blood smears from various samples
 - iii. Staining techniques - simple, differential, special staining methods - capsule, spore, flagella etc.
 - iv. Gram Staining
 - v. Acid Fast staining (with modifications).
 - vi. Leishman & Giemsa for demonstration of intracellular pathogen bacteria, parasite, fungi etc.
 - vii. Albert staining.
- c. Fluorescent staining
 - i. Auramine staining - Mycobacterium tuberculosis.
 - ii. QBC – for malaria.
 - iii. Calcoflor white staining for fungus
- d. Isolation of pathogens
 - i. Preparation of glass wares
 - ii. Sterilization procedures
 - iii. Media preparation-required for isolation & identification
 - iv. Quality check of all media - functional as well as sterility check and maintenance of the record
 - v. Inoculation methods of various samples – surface, streak, stab etc depending on sample
 - vi. Incubation methods - aerobic, anaerobic, microaerophilic, capnophilic depending on the pathogens.
- e. Identification of pathogen
 - i. Colony characters – various characters to be noted in different media.
 - ii. Staining to identify – Gram's / Alberts / Acid Fast/ Lactophenol cotton blue depending on pathogen.

- iii. Motility by hanging drop preparation and other methods.
 - iv. Biochemical reactions - phenotypic-enzymatic, oxidative fermentative, sugar fermentation, other special tests helping to identify up to species level.
 - v. Serotyping.
- f. Antibiotic Susceptibility Testing
 - i. Selection of antibiotic disks as per CLSI/EUCAST based on the probable identification of organism - bacteria, fungi.
 - ii. Detection of drug resistant strains - MRSA, VISA, VRE, ESBL, MBL, CRE etc.
 - iii. Disc diffusion, Agar dilution and Broth microdilution methods for bacteria and fungi.
- **Immunological tests**
 - i. Collection, preparation and storage of samples
 - ii. Perform Rapid tests / /Latex agglutination/ ICT/ELISA etc
- **Molecular tests**
 - i. PCR/RTPCR – all steps till interpretation
 - ii. CBNAAT
- **Biomedical waste management skills.**
- **Quality control skills in all areas.**

➤ **Clinical Microbiology Skills**

(Infectious Disease Case Based Skill)

- i. Demonstrate ability to take and interpret the history of infectious disease case.
- ii. Be able to clinically examine the case and diagnose.
- iii. Take decision for choice of samples to be collected for diagnosis
- iv. Suggest optimum choice of antimicrobial agent to be prescribed with reasons.

➤ **Infection Prevention and Control Skills-**

- i. Hand hygiene skills
- ii. Donning and doffing of PPE

- iii. Transmission based precautions in patient care
- iv. Segregation and disposal of biomedical waste in laboratory and hospital
- v. Handling of sharps
- vi. Post-exposure prophylaxis when exposed to blood and body fluids
- vii. Spillage management
- viii. Sterilization policy of environment and devices in the hospital as per the latest guidelines.
- ix. Calculation of HAI infection rates.
- x. Plan & conduct HAI surveillance & infection control audits

C 2. Should be able to **perform under supervision** and/or interpret the results of the following desirable procedures independently or as a part of a team:

- Demonstration of microbe by:
 - i. IF – autoimmune diseases
 - ii. IF – antigen demonstration in fungi/viral infection /cellular changes
- Isolation & Identification using newer automated systems for bacterial identification, Mycobacterial culture and Mycobacterial susceptibility
- Immunological test
 - i. Nephelometry/ turbidometry method for quantitative CRP/ASO/RA test
 - ii. Chemi-Luminiscence Immuno Assay
- Perform molecular & newer diagnostic tests for diagnosis of infectious disease.

C 3. Should observe the following procedures independently or as a part of a team and/or interpret the results of : (optional)

- Demonstration of microbes by Electron microscope
- Viral culture & identification of growth of viruses
- Immunological test

- iii. Quantiferon
 - iv. Flowcytometry
- Molecular -
 - i. Genome Sequencing methods
 - ii. Molecular typing.

Note: If any of the above facilities are not available in the institute effort to collaborate and post the students in nearby laboratory to acquire the skills shall be made.

TEACHING AND LEARNING METHODS

General principles

Acquisition of competencies being the keystone of doctoral medical education, such training should be skills oriented. Learning in the program, essentially autonomous and self-directed, and emanating from academic and clinical work, shall also include assisted learning. The formal sessions are meant to supplement this core effort.

All students joining the postgraduate (PG) courses shall work as full-time (junior) residents during the period of training, attending not less than 80% of the training activity during the calendar year, and participating in all assignments and facets of the educational process. They shall maintain a logbook for recording the training they have undergone, and details of the procedures done during laboratory and clinical postings in real time.

Teaching-Learning methods

This should include a judicious mix of demonstrations, symposia, journal clubs, clinical meetings, seminars, small group discussion, bed-side teaching, case-based learning, simulation-based teaching, self-directed learning, integrated learning, interdepartmental meetings and any other collaborative activity with the allied departments. Methods with exposure to the applied aspects of the subject relevant to basic/clinical sciences will be used. The frequency of various below mentioned teaching-learning methods can vary based on the subject's requirements,

competencies, work load and overall working schedule.

A. Lectures: A minimum of 10 lectures per year is suggested. All postgraduate trainees will be required to attend these lectures. Lectures cover topics such as:

1. Important Microbiology topics
2. Recent advances
3. Research methodology and biostatistics
4. Salient features of Postgraduate medical curriculum
5. Teaching and assessment methodology.

Topic numbers 3, 4 & 5 can be done during research methodology/biostatistics and medical education workshops in the institute.

B. Journal club: Minimum of once in 1-2 weeks is suggested.

Topics will include presentation and critical appraisal of original research papers published in peer reviewed indexed journals. The presenter(s) shall be assessed by faculty and grades recorded in the logbook.

C. Student Seminar: Minimum of once every 1-2 weeks is suggested.

Important topics shall be selected and allotted for in-depth study by a postgraduate student. A teacher shall be allocated for each seminar as faculty moderator to help the student prepare the topic well. It should aim at comprehensive evidence-based review of the topic. The student should be graded by the faculty and peers.

D. Student Symposium: Minimum of once every 3 months.

A broad topic of significance shall be selected, and each part shall be dealt by one postgraduate student. A teacher moderator shall be allocated for each symposium and moderator shall track the growth of students. The symposium should aim at an evidence-based exhaustive review of the topic. All participating postgraduates shall be graded by the faculty and peers.

E. Laboratory work: Minimum- once every 1-2 weeks.

Laboratory work teaching shall be coordinated and guided by faculty from the department.

Various methods like DOAP (Demonstrate, Observe, Assist, Perform), simulations in skill lab, and case-based discussions etc. are to be used.

F. Interdepartmental colloquium

Faculty and students must attend monthly meetings between the main Department and other department/s on topics of current/common interest or clinical cases.

G. a. Rotational clinical / community / institutional postings (As per Table I)

Depending on our institutional policy, postgraduate trainees will be posted in relevant departments/ units/ institutions. The aim would be to acquire more in- depth knowledge as applicable to the subject.

Clinical / Practical Training Schedule in Microbiology

The three-year training programme in microbiology is arranged in the form of rotational postings to different sections/laboratories/departments/disciplines for specified periods. Providing a suitable learning environment to develop clinical insight and achieve the outcomes of a medical microbiologist will be the driving force while planning posting schedules, which may be modified depending on needs, feasibility and exigencies. Student shall be posted for various duration in different sections of Microbiology (like Bacteriology, Serology, Virology, Parasitology, Immunology, Mycobacteriology, Mycology, Molecular testing and Hospital infection control), patient care areas in hospital (like emergency, OPDs, critical care areas, surgical and medical wards etc) as well as in community outreach programs, so that they can learn specific requirements of each section and participate in patient care and prevention of infectious diseases in the hospital as well as community. These postings are meant to provide hands-on training and develop required skills in clinical and laboratory medicine of microbiology.

Table 1. Following is the suggested plan of Rotation for Postgraduate students Postings to Diagnostic Laboratories/Hospital/ Community-

Sr no	Schedule of Rotation	Duration & Professional year	Suggested Specific Learning Objectives
1	<p>Microbiology laboratory</p> <ul style="list-style-type: none"> i. Different sections of Bacteriology ii. Media preparation iii. Mycobacteriology iv. Serology/Immunology v. Mycology vi. Virology vii. Parasitology viii. Molecular lab ix. Hospital Infection Control including BMW management 	<p>Distributed in various section depending upon training & departmental needs</p> <p>I, II & III year</p>	<ul style="list-style-type: none"> As per the specific objectives in each section, a student is expected to acquire skills from basic to the most recent ones in diagnostic microbiology.
2	Sample Collection area	<p>Two weeks</p> <p>I year</p>	<ul style="list-style-type: none"> To learn pre-analytical parameters & procedures at sample collection area.

			<ul style="list-style-type: none"> • To communicate effectively with patients at sample collection area. • Learn to demonstrate respect, empathy & confidentiality when dealing with patients, samples and reports. • Demonstrate leadership skills in managing the functioning of the lab (staff management, preparing duty roster)
3	<p>Clinical Pathology</p> <p>i. Hematology</p> <p>ii. Histopathology</p> <p>iii. Blood Bank</p>	<p>Two weeks</p> <p>I year</p>	<ul style="list-style-type: none"> • Basic knowledge of clinical pathology (as applied to Microbiology) • Inflammation and repair • Intercellular substances and reaction • Pathological changes in the body in bacterial, viral, mycotic and parasitic infections <p>Clinical Pathology skills:</p> <ul style="list-style-type: none"> • Peripheral smear examination • CBC interpretation • Urine examination • Pathological investigations and their significance in infectious disease diagnosis.

			<p>Blood Bank skills:</p> <ul style="list-style-type: none"> • Transfusion transmitted infection Blood grouping • Screening of blood & blood donors • Counseling skills <p>Histopathology skills:</p> <ul style="list-style-type: none"> • Various stains and staining techniques used in histopathological examination of infectious agents • Identification of pathogen and/or pathological changes in tissue sections in infectious diseases.
4	Clinical Biochemistry	<p>One week</p> <p>I year</p>	<ul style="list-style-type: none"> • Basic understanding of biochemistry as applied to immunological/ molecular methods for study of microbial diseases and pathogenesis of infections. • Significance of biochemical markers/profile in diagnosis, prognosis and monitoring of infective syndromes like sepsis

5	ICTC /PPTCT/ART	Two weeks I year	<ul style="list-style-type: none"> • HIV counseling skills • HIV Testing strategies • HIV Surveillance strategies • Treatment regimens in HIV positive case, management of drug resistance, and prophylaxis PEP, prevention & management of opportunistic infection
6	Tuberculosis and RNTCP	Two weeks I year	<ul style="list-style-type: none"> • Diagnosis of Pulmonary and extra pulmonary TB • Fluorescent Microscopy for TB • Molecular diagnosis • National tuberculosis Elimination Program • Treatment regimens in susceptible and drug resistant TB cases
7	District hospital postings (mandatory) 3rd or 4th semester for 3 months	Three months* II year	<ul style="list-style-type: none"> • Identify types of infections seen in community • Identify lacuna in KAP in community that promote development of infections • Choice of antimicrobials and treatment plan for infections in community • Infection control in community • Should contribute to strengthen the

			<p>services of the district health system, the diagnostic laboratory services.</p> <ul style="list-style-type: none"> • Participate in public health programs & research activities
8	<p>Clinical locations –</p> <p>i. Medicine & allied (General Medicine, Respiratory Disease, Skin & Venereal Disease)</p> <p>ii. Pediatrics</p> <p>iii. Surgery & allied (General Surgery, Orthopedic)</p> <p>iv. Obstetric and Gynecology</p>	<p>Two months</p> <p>Posting to be done for morning half of the day</p> <p>II year</p>	<p>Depending on the area of posting-</p> <ul style="list-style-type: none"> • History taking and physical examination skills • Sample collection and transportation skills • Identification of common infections and make a differential diagnosis • Choose the appropriate laboratory investigations required for confirmation of diagnosis • Interpret the laboratory results and correlate them clinically. • Learn common treatment plan, particularly choice of antimicrobials and identify factors that influence choice of antimicrobials. • Acquire reasoning and critical thinking required in decision making when dealing with an infectious disease case • Infection control practices

9	Critical care units- i. Medical ICU ii. Surgical ICU iii. Neonatal/Pediatric ICU	Three weeks (in morning half day) III year	<ul style="list-style-type: none"> • All above in a critical setting along with • Availability and choice of specialized investigations necessary for optimum management of a critical patient with ID. Significance and adherence to antibiotic policy and antibiotic stewardship program Infection control in ICU
10	Institutional Super specialty wing if available Dialysis, Oncology, Cardiology etc	One week (morning half day) III year	<ul style="list-style-type: none"> • To study infections seen in special situations along with their management & prevention approach
	Total duration of posting outside microbiology laboratory	33 weeks	

Depending upon the objectives to be achieved, feasibility and availability of resources, the rotational postings shall be within the hospital or outside the hospital.

During the clinical posting, opportunities to present and discuss infectious disease cases through bedside discussion and ward/grand rounds with clinicians in different hospital setting shall be scheduled.

The PG student shall be tagged along with the resident of the clinical department for bedside case discussion, under the guidance of an assigned faculty. A minimum of five case histories shall be recorded by a student during course of study. The case history shall be representative of different type of Infectious Disease (ID) cases likely to be encountered eg., those caused by different microbes in community and hospital setting, HAI, infections in critical care/ ward setting, infection in different age groups, infections in special host like Immunocompromised

host, traveller, specific occupations etc.

The process of recording case histories shall begin in first half of 2nd year of PG program, after students have learnt about various infective syndromes. The severity and complexity of cases must progress gradually, with simple community-based infection to begin with. At least one fourth of the cases recorded must have been discussed with the ID specialist or a clinician and their feedback/remarks documented in log book/ portfolio with their signatures.

Documentation of students learning at the end of each posting is required.

Emergency duty

The student shall also be posted for managing emergency laboratory services in Microbiology. He/she shall deal with all emergency investigations in Microbiology.

G. b. *Posting under “District Residency Programme” (DRP):

All postgraduate students pursuing MD/MS in broad specialties in all Medical Colleges/Institutions shall undergo a compulsory rotation of three months in District Hospitals/District Health System as a part of the course curriculum, as per the Postgraduate Medical Education (Amendment) Regulations (2020). Such rotation shall take place in the 3rd or 4th or 5th semester of the Postgraduate programme and the rotation shall be termed as “District Residency Programme” and the PG medical student undergoing training shall be termed as “District Resident”. The PG student shall be tagged along with those of other relevant departments for bedside case discussion/basic science exercises as needed, under the guidance of an assigned faculty.

Opportunities to present and discuss infectious disease cases through bedside discussion and ward/grand rounds with specialists / clinicians in different hospital settings shall be scheduled to address antimicrobial resistance issues and strategies to deal with it.

H. Teaching research skills

Writing a thesis should be used for inculcating research knowledge and skills. All postgraduate students shall conduct a research project of sufficient depth to be presented to the University as a postgraduate thesis under the supervision of an eligible faculty member of the department as

guide and one or more co-guides who may be from the same or other departments.

In addition to the thesis project, every postgraduate trainee shall participate in at least one additional research project that may be started or already ongoing in the department. It is preferable that this project will be in an area different from the thesis work. For instance, if a clinical research project is taken up as thesis work, the additional project may deal with community/field/laboratory work. Diversity of knowledge and skills can thereby be reinforced.

I. Training in teaching & learning skills

MEU/DOME shall train PG students in education methodologies and assessment techniques. The PG students shall conduct UG classes in various courses and a faculty shall observe and provide feedback on the teaching skills of the student.

J. Log book

During the training period, the postgraduate student shall maintain a Log Book indicating the duration of the postings/work done in Wards, OPDs, Casualty and other areas of posting. This shall indicate the procedures assisted and performed and the teaching sessions attended. The log book entries must be done in real time. The logbook is thus a record of various activities by the student like: (1) Overall participation & performance, (2) attendance, (3) participation in sessions, (4) record of completion of pre-determined activities, and (5) acquisition of selected competencies.

The purpose of the Log Book is to:

- a) Help maintain a record of the work done during training.
- b) Enable Faculty/Consultants to have direct information about the work done and intervene, if necessary.
- c) Provide feedback and assess the progress of learning with experience gained periodically.

The Log Book shall be used in the internal assessment of the student, shall be checked and assessed periodically by the faculty members imparting the training. The PG students will be required to produce completed log book in original at the time of final practical examination. It shall be signed by the Head of the Department. A proficiency certificate from the Head of Department regarding the clinical competence and skillful performance of procedures by the

student will be submitted by the PG student at the time of the examination.

The PG students shall be trained to reflect and record their reflections in logbook particularly of the critical incidents. Components of good teaching practices must be assessed in all academic activity conducted by the PG student and at least two sessions dedicated for assessment of teaching skills shall be conducted every year of the PG program.

K. Course in Research Methodology: All postgraduate students shall complete an online course in Research Methodology within six months of the commencement of the batch and generate the online certificate on successful completion of the course.

Other aspects

- The Postgraduate trainees shall participate in the teaching and training program of undergraduate students and interns attending the department.
- Trainees shall attend accredited scientific meetings (CME, symposia, and conferences) at least once a year.
- Department shall encourage e-learning activities.
- The Postgraduate trainees shall undergo training in Basic Cardiac Life Support (BCLS) and Advanced Cardiac Life Support (ACLS).
- The Postgraduate trainees shall undergo training in information technology and use of computers.

Skills & performance

The student shall be given graded responsibility to enable learning by apprenticeship. The faculty throughout the year shall assess competence of the student in skills. Feedback will be given and area of improvement/remarks shall be mentioned for the skill and student shall be re-assessed for the skills which are not acquired. To go to the next level, it shall be mandatory for the student to acquire lower level skills satisfactorily, i.e only on satisfactory completion of assisted/performed with assistance skills shall the student be permitted to perform the skill independently.

ASSESSMENT

I. FORMATIVE ASSESSMENT, ie., assessment to improve learning

Formative assessment shall be continual and shall assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self-directed learning and ability to practice in the system.

General Principles

The Internal Assessment shall be conducted in theory and practical examination, shall be frequent, covering all domains of learning and shall be used to provide feedback to improve learning; it shall also cover professionalism and communication skills.

Quarterly assessment during the MD training shall be based on:

- Journal club- Paper presentation & discussion
- Seminar/Lecture/ group discussion
- Case based /Laboratory or Skill based discussions
- Interdepartmental case or seminars, clinical microbiology round/ grand round/ seminar-discussion

Note: These sessions may be organized and recorded as an institutional activity for all postgraduates.

- Attendance at Scientific meetings, CME programmes

The student is to be assessed periodically as per categories listed in the postgraduate student appraisal form (**Annexure II**).

II. SUMMATIVE ASSESSMENT, i.e., assessment at the end of training

Essential pre-requisites for appearing for examination include:

1. **Log book** of work done during the training period including rotation postings, departmental presentations, and internal assessment reports shall be submitted.

2. At least two presentations at national level conference. One research paper shall be published / accepted in an indexed journal/ sent for publication during the period.

The summative examination would be carried out as per the Rules given in the latest POSTGRADUATE MEDICAL EDUCATION REGULATIONS. The theory examination shall be held in advance before the Practical examination, so that the answer books can be assessed and evaluated before the commencement of the Practical and Oral examination.

The postgraduate examination shall be in three parts:

1. Thesis

During the course of study every candidate has to prepare a dissertation individually on selected topic under the direct guidance and supervision of a recognized post graduate teacher.

The suggested time schedule for dissertation work is:

- Identification and selection of topic for dissertation - in first 4 weeks.
- Preparatory work for dissertation /synopsis including pilot study if necessary and submission of the synopsis to the University within first 6 months from the beginning of course or as per the dates notified by the University.
- Data collection for dissertation. Writing the dissertation in the following 1½ years.
- Submission of the dissertation six months prior to the final examination or as per the dates notified by the University.

Registration of dissertation topic

- Every candidate shall submit a synopsis in the prescribed proforma of the University for registration of dissertation topic. Subject of dissertation will be scrutinised by the PG training cum research committee and ethical committee of the institution. The synopsis shall be sent within first 6 months from the commencement of course as notified in the University calendar of events, to the Registrar (Academic).

Submission of dissertation

Thesis shall be submitted at least six months before the Theory and Practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and Practical examination. A postgraduate student in broad specialty shall be allowed to appear for the Theory and Practical examination only after the acceptance of the Thesis by the examiners.

2. Theory examination

The examinations shall be organized on the basis of 'Grading 'or 'Marking system' to evaluate and to certify postgraduate student's level of knowledge, skill and competence at the end of the training, as given in the latest POSTGRADUATE MEDICAL EDUCATION REGULATIONS. Obtaining a minimum of **50% marks in 'Theory' as well as 'Practical' separately** shall be mandatory for passing examination as a whole. The examination for M.D shall be held at the end of 3rd academic year.

SCHEME OF UNIVERSITY EXAMINATION

Theory consists of four papers each of 100 marks

For three hours duration - 400 Marks

Practical conducted for 2 days - 200 Marks

Viva-voce & Pedagogy - 100 Marks

Maximum marks for	Theory	Practical	Viva-voce (Pedagogy & Thesis discussion)	Total
MD Microbiology Examination	400	200	100	700

There shall be four theory papers (as per PG Regulations).

**Paper I- General Microbiology and Immunology (GM & IG).Paper II–
Clinical / Systemic Microbiology (CM I).**

Paper III– Clinical / Systemic Microbiology (CM II).

Paper IV- Recent Advances & Applied Microbiology (AM).

Each theory paper will consist of:

Long Essay type questions - 2 X 20 marks= 40

Short Essay type questions - 6 X 10 marks= 60

Theory paper	Topics	Marks weightage
Paper I	General Microbiology & Immunology	General Microbiology (50%) + Immunology (50%)
Paper II	Clinical / Systemic Microbiology - I	40-50% Bacterial, 20-30% Viral, 10-20 % each for Mycobacterial, Parasitic & Fungal pathogens.
Paper III	Clinical / Systemic Microbiology - II	40-50% Bacterial, 20-30% Viral, 10-20 % each for Mycobacterial, Parasitic & Fungal pathogens.
Paper IV	Recent Advances & Applied Microbiology	Recent advances (50%) + Applied Microbiology (50%)

60-70% weightage shall be given to higher levels in Blooms taxonomy (application and above) in theory with more number of clinical scenario based questions.

In Paper II/III (CM – II/III) –distribution of Clinical Scenarios testing the ability of a student to deal with infections caused by various etiological agents is suggested to be 40-50% Bacterial, 20-30% Viral, 10-20 %each for Mycobacterial, Parasitic & Fungal pathogens.

Note: The topics assigned to the different papers are given as general guidelines. A strict division of subjects may not be possible. Some overlapping of topics is inevitable. Students should be prepared to answer the overlapping topics.

3. Practical/Clinical and Oral/Viva Voce examination

Practical examination

Practical examination shall be spread over two days and include various major components of the syllabus focusing mainly on the psychomotor & affective domain.

Type of Exercises for Practical Examination shall include cases (actual or paper based depending on the feasibility) of infectious diseases for workup and evaluation of clinical microbiology competence along with exercises to test ability to perform bacteriology,

virology, parasitology, mycology, mycobacteriology, immunology, serology with microscopic examination and antimicrobial susceptibility report.

Table 2. Suggested Day wise distribution of practical exercises:

Ex. No	Day -1	Ex. No	Day-2
1	Clinical Microbiology exercise (Give a real clinical case /paper based scenario addressing commonly seen cases in bacteriology/mycobacteriology/virology/mycology/parasitology/HAI /AMR/out break /national project based etc of infectious diseases to the PG for workup and evaluation with respect to case history, basic physical examination, required investigations, interpretation of diagnostic test results, and therapeutic management decisions including prescription of antibiotics, along with IC practices)	1 cont	Clinical Microbiology exercise -Conclusion
2	Long Exercise- Bacteriology (Mixed culture given with a clinical history representing any specimen collected from respective systemic infection)	2 cont	Long Exercise - Bacteriology conclusion
3	Short Exercise – Bacteriology (Identification of a pure culture)	3 cont	Short Exercise - Bacteriology conclusion

4	Serology Exercise (In a clinical case, choice of test & technique with interpretation of test results)	4 cont	Serology cont. if required
5	Virology techniques (In a clinical case, choice of test & technique with interpretation of test results. Viral serology/ Molecular techniques depending upon availability)	5 cont	Virology cont. if required
6	Mycology (Identification of fungi in a clinical case)	6 cont	Mycology cont. if required
7	Parasitology (In a clinical case, choice of test & technique with interpretation of test results Stool examination, Examination of Peripheral blood smear etc)	9	Pedagogy (10-15minutes)
8	Slides (Slides including histopathology for microscopic identification & discussion)	10	Log book, Dissertation Viva, Grand-Viva

Sl no.	Exercise	Marks
1	Ex-1 – Clinical Microbiology exercise	30
	Ex-2 – Mixed culture (Bacteriology)	30
	Ex-3 - Pure culture (Bacteriology)	30
	Ex-4 – Serology	20
	Ex-5 – Virology	25
	Ex-6 - Mycology	25
	Ex-7 – Parasitology	20
	Ex-8 - Slide discussion	20
Marks	Practical Total Marks	200
	Viva-voce (80) + Pedagogy (20)	100
	Total	300

Oral/Viva voce examination: Oral examination shall be comprehensive to test the postgraduate student's overall ability to apply knowledge of the subject to hospital/community/research areas focusing on cognitive, psychomotor and affective domain skills.

- a) The Viva-Voce would be on all components of syllabus including discussion on dissertation - **80 marks**
- b) Pedagogy/Microteaching of not more than 15 minutes duration - **20 marks**

Recommended Reading

Books (latest edition)

1. Forbes B, Sahm D, Weissfeld A. *Bailey and Scott's Diagnostic Microbiology*, Mosby, St. Louis.
2. Koneman EW, Allen SD, Janda WM, Schreckenberger PC, Winn WC. *Color Atlas and Textbook of Diagnostic Microbiology*, J.B. Lippincott, Philadelphia.
3. Murray PR, Baron EJ, Pfaller MA, Tenover FC, Tenover FC. *Manual of Clinical Microbiology*, American Society for Microbiology.
4. Garcia LS, Bruckner DA. *Diagnostic Medical Parasitology*, American Society for Microbiology.
5. Mackie & McCartney Practical Medical Microbiology by J.G. Collee, A.G. Fraser
6. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases: by John E. Bennett, Raphael Dolin, Martin J. Blaser
7. Manson's Tropical Diseases by Jeremy Farrar; Peter J. Hotez; Thomas Junghanss Gagandeep Kang; David Lalloo; Nicholas J. Wh
8. Harrison's Infectious Diseases, by Dennis L. Kasper; Anthony S. Fauci
9. Hunter's Tropical Medicine and emerging infectious disease by Edward T. Ryan, David R. Hill, Timothy P. Endy
10. Clinical Immunology Principles and Practices by Robert Rich
11. Anaerobic Bacteriology, Clinical and Laboratory practice by A. Trevorwillis
12. Topley & Wilson, Principles of Bacteriology, Virology and Immunity by M.T. Parker and L.H. Collier
13. Topley and Wilson's Microbiology and Microbial infection by Brian W. J. Mahy, Graham Selby Wilson, and William Whiteman Carlton Topley
14. Text book of Medical Mycology by Jagadish Chandra
15. Atlas of Fungal infection by Carol A. Kauffman
16. Bennett and Brachman's Hospital Infection, 6th edition, William R Jarvis.
17. Ivan Roitt, Essential Immunology

18. Stites, Clinical Basic Immunology
19. Jawetz, Melnick and Adelbergs, Medical Microbiology, Mc Graw Hill Education
20. Text book of Microbiology by Anantha narayan & Paniker. OrientLongman
21. Text book of Microbiology by Dr Apurba Sastry & Dr Sandhya Bhat. Jaypee publishers

Journals

#	Journals Name	International/National
1	The Journal of Infectious Diseases (F)	International
2	Immunology and Allergy Clinics (Q)	International
3	Infectious Disease Clinics (Q)	International
4	The JI of LabClinical Medicine:Translation Research (BM)	International
5	Jl of the Academy of Clinical Microbiologist (Q)	National
6	Indian Jl.of Microbiology (Q)	National
7	Indian Jl of Immunology & Respiratory Medicine (Q)	National
8	Indian Journal of Allergy Asthma & Immunology (Q)	National

Annexure I

Following are the competencies to be achieved under Antimicrobial Resistance Detection and Prevention:

1. Demonstrate in depth knowledge of classification, mechanism of action and drug resistance of antimicrobials (antibacterials, antiviral, antifungal, antimycobacterial and antiparasitic agents).
2. Explain various phenotypic and genotypic methods used in laboratory for detection of drug resistant strains and their implications in patient care.
3. Demonstrate skills in performing antimicrobial susceptibility testing with calculations of MIC/MBC by various phenotypic and genotypic methods and interpret results as per standard guidelines (CLSI, EUCAST etc).
4. Detect and report bacterial drug resistance by identification of the commonly isolated drug resistant strains (MRSA, VRSA, VRE, CRE, MBL, AMP-C etc) and choose the most appropriate agent for therapeutic use in a specific clinical scenario.
5. Explain the implications of AST result on antimicrobial therapy to clinicians/colleagues.
6. Communicate effectively with clinicians to guide and create an antimicrobial treatment plan based on organism identification and susceptibility test.
7. Explain the concept of narrow/broad spectrum of antimicrobials, PK/PD parameters and their significance on response to antimicrobial therapy.
8. Explain significance of monitoring of antimicrobial therapy in patient care.
9. Explain the concept of empiric, syndromic and culture-based treatment strategies for treating infections.
10. Explain the need to de-escalate from empirical broad-spectrum therapy to targeted narrow-spectrum therapy.
11. Explain the importance of appropriate use of antimicrobial agents, risk of antimicrobial resistance and spread of AMR in the health care environment and the community.
12. Explain the concept of normal microbial flora, colonization, contamination and infection with its role in deciding antimicrobial therapy.

13. Demonstrate knowledge about antimicrobial prophylaxis including peri-operative surgical prophylaxis regimens.
14. Describe the concept of first-, second- and third-line antimicrobial therapy for infections.
15. Explain the importance of restricted reporting of susceptibility data by the laboratory to control antimicrobial use.
16. Explain the concept and application of WHO tool for optimizing use of antimicrobial agents: Access, Watch and Reserve (AWaRe).
17. Explain the importance of antimicrobial formularies, consumption data and prescribing policies and processes to monitor use of antimicrobials in hospitals.
18. Effectively use information technology (LIS, WHO NET etc.) for data collection and surveillance of AMR in microbiology laboratory.
19. Explain significance of collecting local antimicrobial resistance data and its use in deciding direct empirical antimicrobial therapy.
20. Demonstrate knowledge and skills to develop antibiotic policy by using local AMR data in hospital.
21. Explain significance of adherence to antibiotic policy and antibiotic stewardship program.
22. Be a part of antimicrobial stewardship team for the institution.
23. Demonstrate knowledge about recent published guidelines that recommend antimicrobial treatment therapy in various clinical situations.
24. Effectively communicate with the patients/ relatives about the role of antimicrobial agents in their disease and advice on appropriate use.
25. Actively engage with patients, relatives and the community to advise on the role of antimicrobial agents in therapy and the threat of resistance.
26. Participate in clinical audit and quality improvement programmes relating to antimicrobial use.
27. Teach students, colleagues and other health professionals regarding antimicrobial use and resistance.

Student appraisal form for MD in Microbiology											
	Elements	Less than Satisfactory			Satisfactory			More than satisfactory			Comments
		1	2	3	4	5	6	7	8	9	
1	Scholastic aptitude and learning										
1.1	Has knowledge appropriate for level of training										
1.2	Participation and contribution to learning activity (e.g., Journal Club, Seminars, CME etc)										
1.3	Conduct of research and other scholarly activity assigned(e.g Posters, publications etc)										
1.4	Documentation of acquisition of competence (eg Log book)										
1.5	Performance in work based assessments										
1.6	Self-directed Learning										
2	Work related to training										
2.1	Practical skills that are appropriate for the level of training										
2.2	Respect for processes and procedures in the work space										

2.3	Ability to work with other members of the team										
2.4	Participation and compliance with the quality improvement process at the work environment										
2.5	Ability to record and document work accurately and appropriate for level of training										
3	Professional attributes										
3.1	Responsibility and accountability										
3.2	Contribution to growth of learning of the team										
3.3	Conduct that is ethically appropriate and respectful at all times										
4	Space for additional comments										
5	Disposition										
	Has this assessment pattern been discussed with the trainee?	Yes	No								
	If not explain.										
	Name and Signature of the assessee										
	Name and Signature of the assessor										
	Date										