



**BHARATI VIDYAPEETH  
(DEEMED TO BE UNIVERSITY), PUNE**

**Faculty of Medical Sciences  
MD - MICROBIOLOGY  
New Syllabus**



**Bharati Vidyapeeth Deemed to be University,  
Pune**

**Faculty of Medical Sciences**

**Curriculum for MD in Biochemistry  
As per Guidelines of  
National Medical Commission**

**NATIONAL MEDICAL COMMISSION**  
**Postgraduate Medical Education Board**

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**GUIDELINES FOR COMPETENCY BASED  
POSTGRADUATE TRAINING  
PROGRAMME FOR MD IN  
MICROBIOLOGY**

# **GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN MICROBIOLOGY**

## **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, a microbiologist needs to develop clinical expertise in addition to technical expertise and be available more at the bedside to develop partnership with clinician in diagnosis and management of infectious disease cases. To fulfill these expectations, the program of MD Microbiology needs to shift focus to clinical aspects of microbiology, where a student is trained in the clinical setting and is able 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 throughout the country and fulfill the expectations as a microbiologist. The new curriculum guide has given 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 has been prepared by subject-content specialists for the National Medical Commission. The Expert Group of the National Medical Commission had attempted to render uniformity without compromise to the purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

## ***SUBJECT SPECIFIC OBJECTIVES (GOALS)***

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.
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 should include 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 competencies will have a judicious mix of all domains of learning and may show predominance in one domain. The Post-Graduate student during the training



programme should acquire the following predominant domain specific competencies to achieve the defined goals:

### **A) Predominant in 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.

- 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 clinic-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 must be 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 marneffeii* 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. Virioids
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* *Iso spora*, *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*, *Filariasis* 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, immune 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. Investigation of an infectious disease outbreak in hospital and outbreak/epidemic/pandemic in community.
- viii. Information technology (computers) in microbiology.
- ix. Automation in Microbiology.
- x. Molecular techniques in the laboratory diagnosis of infectious diseases.
- xi. Statistical analysis of microbiological data and research methodology.
- xii. Animal and human ethics involved in microbiological work.
- xiii. Laboratory safety and management.

## **B. Predominant in Affective Domain**

- i. Communicate effectively & empathically with patients and their relatives during sample collection, history taking, counseling and reporting results.
- ii. Acquire Consent taking and counseling skills and demonstrate these to undergraduates.
- iii. Communicate effectively with peers, and consultants for better clinical correlation of laboratory findings as well as research.
- iv. Demonstrate effective communication and attitudinal skill while teaching undergraduate students.

- v. Function as an effective team member and leader with good conflict management skills.
- vi. Adopt ethical principles, particularly maintenance of confidentiality when dealing with laboratory reports.
- vii. Demonstrate ability to recognize and manage ethical and professional conflicts and abide by prescribed ethical and legal codes of conduct and practice.
- viii. 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\*:**

➤ **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. Broth microdilution methods for bacteria and fungi.
- **Immunological tests**
  - i. i. Collection, preparation and storage of samples
  - ii. 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-Luminescence 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 should also be used. **The suggested examples of teaching-learning methods are given below but are not limited to these. The frequency of various below mentioned teaching-learning methods can vary based on the subject's requirements, competencies, work load and overall working schedule in the concerned subject.**

**A. Lectures:** Didactic lectures should be used sparingly. A minimum of 10 lectures per year in the concerned PG department is suggested. Topics to be selected as per requirements of the subject. All postgraduate trainees will be required to attend these lectures. Lectures can cover topics such as:

1. Subject related important topics as per specialty requirement
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 should be selected as per subject requirements and allotted for in-depth study by a postgraduate student. A teacher should 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 should be selected, and each part shall be dealt by one postgraduate student. A teacher moderator should be allocated for each symposium and moderator should track the growth of students. The symposium should aim at an evidence-based exhaustive review of the topic. All participating postgraduates should be graded by the faculty and peers.

**E. Laboratory work / Bedside clinics:** Minimum- once every 1-2 weeks.

Laboratory work/Clinics/bedside teaching should 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. Faculty from the department where a student is posted should participate in moderating the teaching-learning sessions during clinical rounds.

**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 local institutional policy and the subject specialty needs, postgraduate trainees may be posted in relevant departments/ units/ institutions. The aim would be to acquire more in-depth knowledge as applicable to the concerned specialty. Postings would be rotated between various units/departments and details to be included in the specialty-based Guidelines. Few examples are listed below:

- Broad specialty departments
- Emergency/Casualty department
- Super specialty departments e.g. Cardiology / Endocrinology / Nephrology / Medical Oncology etc.
- Laboratory-based specialty units/departments e.g. Biochemistry / Microbiology/ Infection control unit/Laboratory Medicine etc.
- Medical Education Unit (MEU) or Department of Medical Education (DOME)

### **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 must be the driving force while planning posting schedules, which may be modified depending on needs, feasibility and exigencies. Student must be posted for various duration in different sections of Microbiology (like Bacteriology, Serology, Virology, Parasitology, Immunology, Mycobacteriology, Mycology 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	Suggested Specific Learning Objectives
1	Microbiology laboratory 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	Distributed in various section depending upon training & departmental needs	<ul style="list-style-type: none"> <li>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.</li> </ul>
2	Sample Collection area	<b>Two weeks</b>	<ul style="list-style-type: none"> <li>To learn pre-analytical parameters &amp; procedures at sample collection area.</li> </ul>



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

			<p><b>Blood Bank skills:</b></p> <ul style="list-style-type: none"> <li>• Transfusion transmitted infection</li> <li>• Blood grouping</li> <li>• Screening of blood &amp; blood donors</li> <li>• Counseling skills</li> </ul> <p><b>Histopathology skills:</b></p> <ul style="list-style-type: none"> <li>• Various stains and staining techniques used in histopathological examination of infectious agents</li> <li>• Identification of pathogen and/or pathological changes in tissue sections in infectious diseases.</li> </ul>
4	Clinical Biochemistry	One week	<ul style="list-style-type: none"> <li>• Basic understanding of biochemistry as applied to immunological/ molecular methods for study of microbial diseases and pathogenesis of infections.</li> <li>• Significance of biochemical markers/profile in diagnosis, prognosis and monitoring of infective syndromes like sepsis</li> </ul>
5	ICTC /PPTCT/ART	Two weeks	<ul style="list-style-type: none"> <li>• HIV counseling skills</li> <li>• HIV Testing strategies</li> <li>• HIV Surveillance strategies</li> <li>• Treatment regimens in HIV positive</li> </ul>

			case, management of drug resistance, and prophylaxis PEP, prevention & management of opportunistic infection
<b>6</b>	Tuberculosis and RNTCP	<b>Two weeks</b>	<ul style="list-style-type: none"> <li>• Diagnosis of Pulmonary and extra pulmonary TB</li> <li>• Fluorescent Microscopy for TB</li> <li>• Molecular diagnosis</li> <li>• National tuberculosis Elimination Program</li> <li>• Treatment regimens in susceptible and drug resistant TB cases</li> </ul>
<b>7</b>	District hospital postings (mandatory) 3rd or 4th semester for 3 months	<b>Three months*</b>	<ul style="list-style-type: none"> <li>• Identify types of infections seen in community</li> <li>• Identify lacuna in KAP in community that promote development of infections</li> <li>• Choice of antimicrobials and treatment plan for infections in community</li> <li>• Infection control in community</li> <li>• Should contribute to strengthen the services of the district health system, the diagnostic laboratory services.</li> <li>• Participate in public health programs &amp; research activities</li> </ul>

8	<b>Clinical locations –</b>  i. Medicine & allied (General Medicine, Respiratory Disease, Skin & Venereal Disease)  ii. Pediatrics  iii. Surgery & allied (General Surgery, Orthopedic)  iv. Obstetric and Gynecology	<b>Two months</b>  Posting to be done for morning half of the day	<b>Depending on the area of posting-</b> <ul style="list-style-type: none"> <li>• History taking and physical examination skills</li> <li>• Sample collection and transportation skills</li> <li>• Identification of common infections and make a differential diagnosis</li> <li>• Choose the appropriate laboratory investigations required for confirmation of diagnosis</li> <li>• Interpret the laboratory results and correlate them clinically.</li> <li>• Learn common treatment plan, particularly choice of antimicrobials and identify factors that influence choice of antimicrobials.</li> <li>• Acquire reasoning and critical thinking required in decision making when dealing with an infectious disease case</li> <li>• Infection control practices</li> </ul>
9	<b>Critical care units-</b>  i. Medical ICU	<b>Three weeks</b>  <b>(in morning half day)</b>	<ul style="list-style-type: none"> <li>• All above in a critical setting along with</li> <li>• Availability and choice of specialized investigations necessary for optimum</li> </ul>

	ii. Surgical ICU iii. Neonatal/Pediatric ICU		management of a critical patient with ID. Significance and adherence to antibiotic policy and antibiotic stewardship program Infection control in ICU
<b>10</b>	Institutional Super specialty wing if available Dialysis, Oncology, Cardiology etc	<b>One week</b> ( morning half day)	<ul style="list-style-type: none"> <li>To study infections seen in special situations along with their management &amp; prevention approach</li> </ul>
	<b>Total duration of posting outside microbiology laboratory</b>	<b>33 weeks</b>	

**\*Posting under “District Residency Programme”**

Depending upon the objectives to be achieved, feasibility and availability of resources, the rotational postings can 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 must be scheduled.

The PG student must 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 must 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, traveler, specific occupations etc.

The process of recording case histories can begin in first half of 2<sup>nd</sup> 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 should also be posted for managing emergency laboratory services in Microbiology. He/she should 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 3<sup>rd</sup> or 4<sup>th</sup> or 5<sup>th</sup> 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”.

Every posting should have its defined learning objectives. It is recommended that the departments draw up objectives and guidelines for every posting offered in conjunction with the collaborating department/s or unit/s. This will ensure that students acquire expected competencies and are not considered as an additional helping hand for the department / unit in which they are posted. The PG student must 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 must 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 should 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 should maintain a Log Book indicating the duration of the postings/work done in Wards, OPDs, Casualty and other areas of posting. This should 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 should be used in the internal assessment of the student, should 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 should 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 must be conducted every year of the PG program. The teaching faculty shall refer to the MCI Logbook Guidelines uploaded on the Website.

**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 must 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 should undergo training in Basic Cardiac Life Support (BCLS) and Advanced Cardiac Life Support (ACLS).
- The Postgraduate trainees must undergo training in information technology and use of computers.



**During the training program, patient safety is of paramount importance; therefore, relevant clinical skills are to be learnt initially on the models, later to be performed under supervision followed by independent performance. For this purpose, provision of skills laboratories in medical colleges is mandatory.**

### **Skills & performance**

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

## ***ASSESSMENT***

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

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

#### **General Principles**

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

The Internal Assessment should be conducted in theory and practical/clinical examination, should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills. At least five clinical cases shall be assessed through discussion of case histories recorded by the students while posted

in clinical setting and recorded along with feedback (preferably by ID specialist if available /clinician).

**Quarterly assessment during the MD training should be based on:**

- Case presentation, case work up, case handling/management
- 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 I1).**

**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 should be submitted.
2. At least **two presentations** at national level conference. One research paper should be published / accepted in an indexed journal. **(It is suggested that the local or University Review committee assess the work sent for publication).**

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 Clinical and Practical examination, so that the answer books can be assessed and evaluated before the commencement of the clinical/Practical and Oral examination.

The postgraduate examination shall be in three parts:

**1. Thesis**

Thesis shall be submitted at least six months before the Theory and Clinical / 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 Clinical examination. A postgraduate student in broad specialty shall be allowed to appear for the Theory and Practical/Clinical 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 3<sup>rd</sup> academic year.

**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).**

Universities shall prepare a blueprint for assessment of competencies and ensure 60-70% weightage is 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.

### 3. Practical/Clinical and Oral/Viva Voce examination

#### Practical examination

Practical examination should 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 should 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,.

**Oral/Viva voce examination:** The simultaneous viva-voce on the clinical case & lab based practical exercise should be taken along with main viva by each examiner separately. Oral examination shall be comprehensive enough to test the postgraduate student's overall ability to apply knowledge of the subject to hospital/community/research areas focusing on psychomotor and affective domain skills.

**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/vir	1 cont	Clinical Microbiology exercise - Conclusion

	<p>ology/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 )</p>		
<b>2</b>	<p>Long Exercise- Bacteriology (Mixed culture given with a clinical history representing any specimen collected from respective systemic infection )</p>	<b>2 cont</b>	<p>Long Exercise - Bacteriology conclusion</p>
<b>3</b>	<p>Short Exercise – Bacteriology (Identification of a pure culture)</p>	<b>3 cont</b>	<p>Short Exercise - Bacteriology conclusion</p>
<b>4</b>	<p>Serology Exercise (In a clinical case, choice of test &amp; technique with interpretation of test results)</p>	<b>4 cont</b>	<p>Serology cont. if required</p>
<b>5</b>	<p>Virology techniques (In a clinical case, choice of test &amp; technique with interpretation of test results. Viral serology/ Molecular</p>	<b>5 cont</b>	<p>Virology cont. if required</p>

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

National Medical Commission

## 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 RH. *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, 6<sup>th</sup> edition, William R Jarvis.

**Journals**

03-05 international Journals and 02 national (all indexed) journals.

**National Medical Commission**



## 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	
<b>1</b>	<b>Scholastic aptitude and learning</b>										
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										
<b>2</b>	<b>Work related to training</b>										
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																		
<b>3</b>	<b>Professional attributes</b>																		
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																		
<b>4</b>	<b>Space for additional comments</b>																		
<b>5</b>	<b>Disposition</b>																		
	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																		

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**BHARATI VIDYAPEETH  
(DEEMED TO BE UNIVERSITY), PUNE**

**Faculty of Medical Sciences  
MD - MICROBIOLOGY  
Old Syllabus**

# **GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN MICROBIOLOGY**

## **Preamble:**

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training.

The purpose of preparing these Guidelines is to standardize Microbiology teaching at Post Graduate level throughout the country so that it will achieve uniformity in undergraduate teaching as well.

This document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board of the Academic Committee has attempted to render uniformity without compromise to purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

## ***SUBJECT SPECIFIC OBJECTIVES***

A post graduate student upon successfully qualifying in the MD (Microbiology) examination should be able to:

1. Demonstrate competence as a clinical microbiologist
2. Interact effectively with the allied departments by rendering services in basic as well as advanced laboratory investigations
3. Demonstrate application of microbiology in a variety of clinical settings to solve diagnostic and therapeutic problems along with preventive measures.
4. Play a pivotal role in hospital infection control, including formulation of antibiotic policy and management of biomedical waste.
5. Acquire skills in conducting collaborative research in the field of Microbiology and allied sciences.
6. Conduct such clinical/experimental research as would have significant bearing on human health and patient care
7. Demonstrate effective communication skills required for the practice of clinical microbiology and while teaching undergraduate students
8. Establish good clinical microbiological services in a hospital and in the community in the fields of bacteriology, virology, parasitology, immunology and mycology.
9. Plan, execute and evaluate teaching assignments in Medical Microbiology.

10. Plan, execute, analyze and present the research work in medical microbiology.
11. To acquire various skills for collaborative research.
12. To participate in various workshops/seminars/journal clubs/demonstration in the allied departments
13. Uphold the prestige of the discipline amongst the fraternity of doctors.

### **Post-graduate training**

The post graduate training should include the following components for a holistic approach.

- a. Laboratory and Diagnostic skills in Clinical Microbiology
- b. Teaching Skills
- c. Research Methodology
- d. Communication and attitudinal skills

#### **a. Laboratory and Diagnostic skills in Clinical Microbiology:**

Based on the available facilities, the department should prepare a list of Post Graduate experiments pertaining to basic, diagnostic and applied Microbiology. Active learning should form the mainstay of the postgraduate training. There should be lectures for the postgraduate students (at least 20 per year) along with seminars/symposia/group discussions and journal clubs. The postgraduate student should also attend a minimum of 20 ward rounds, discuss with the faculty, and maintain a log book for the same. They should be able to render consultative and investigative services in microbiology.

#### **b. Teaching Skills**

The Medical Education Department/Unit of the institution should be able to sensitize the postgraduate students in basic concepts of medical education like domains of learning, teaching skills, teaching - learning methods, learning resource material, evaluation techniques etc. The postgraduate students should attend all undergraduate lectures in the subject of Microbiology and participate actively in the undergraduate teaching programme including tutorials, demonstrations and practicals.

#### **c. Research Methodology**

The postgraduate students should be able to plan, design and conduct research in microbiology, as well as collaborate with other departments, analyze data and become familiar with basic biostatistics. They should also be able to write a research paper. All this can be achieved by writing a thesis on a current and relevant topic in Microbiology.



#### **d. Communication and attitudinal skills**

The post graduate student should be able to communicate effectively with patients, their relatives, peers, and consultants for better clinical correlation of laboratory findings as well as research. They should work as an effective team member and leader. They should also demonstrate right kind of attitude while handling clinical material and reports.

### ***SUBJECT SPECIFIC COMPETENCIES***

#### **A) Cognitive Domain:**

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

##### **General Microbiology**

1. Important historical events and developments in microbiology
2. Basic as well as advanced knowledge in various microscopes and microscopic techniques used in diagnostic microbiology
3. Various bio-safety issues including physical and biological containment, universal containment, personal protective equipment for biological agents
4. Various isolation precautions including standard and transmission based precautions
5. In-depth knowledge about various method of Sterilization, disinfection and lyophilization
6. Nomenclature, classification and morphology of bacteria as well as other microorganisms
7. Various types and significance of normal flora of human body in health and disease states.
8. Requirements for growth and nutrition of bacteria along with bacterial metabolism
9. Various types and role of bacterial toxins and bacteriocins
10. Microbiology of air, milk, water as well as hospital environment
11. Various types of host-parasite relationship and their significance
12. Various antimicrobial agents and mechanisms drug resistance
13. Bacterial genetics, bacteriophages and molecular genetics relevant for medical microbiology
14. Applications of quality assurance, quality control in microbiology and accreditation of laboratories

##### **Immunology**

1. Components of immune system, types of immunity (Innate, acquired, mucosal, humoral and cell mediated immunity) and immune response
2. Describes and identifies uses of various antigens, immunoglobulins (antibodies) and antigen and antibody reactions
3. Complement system and Cytokines
4. Various disorders like hypersensitivity, immunodeficiency and auto-immunity involving immune system
5. MHC complex, Immune tolerance, Transplantation and Tumor immunity
6. Various types, techniques, advances, and applications of vaccines and immunotherapy
7. Measurement of immunological parameters
8. Immunological techniques and their applications in diagnostic microbiology as well as research
9. Mechanisms and significance of immune-potential and immune-modulation

### Systemic bacteriology

1. Demonstrate knowledge and skills in various techniques for isolation and identification of bacteria
2. Demonstrate knowledge about epidemiology, morphology, biochemical properties, antigenic nature, pathogenesis, complications, laboratory diagnosis treatment and prevention of major bacterial pathogens of medical importance given below-
  - a. Gram positive cocci including *Staphylococcus*, *Micrococcus*, *Streptococcus*, anaerobic cocci etc.
  - b. Gram negative cocci including *Neisseria*, *Branhamella*, *Moraxella* etc.
  - c. Gram positive bacilli including *Lactobacillus*, *Coryneform* bacteria, *Bacillus* and aerobic bacilli, *Actinomyces*, *Nocardia*, *Actinobacillus* and other actinomycetales, *Erysipelothrix*, *Listeria*, *Clostridium* and other spore bearing anaerobic bacilli etc.
  - d. Gram negative bacilli including *Vibrios*, *Aeromonas*, *Plesiomonas*, *Haemophilus*, *Bordetella*, *Brucella*, *Gardnerella*, *Pseudomonas* and other non-fermenters, *Pasteurella*, *Francisella*, *Bacteroides*, *Fusobacterium*, *Leptotrichia* and other anaerobic gram negative bacilli etc.
  - e. *Helicobacter*, *Campylobacter*, *Calymmatobacterium*, *Streptobacillus*, *Spirillum* and miscellaneous bacteria
  - f. *Enterobacteriaceae*
  - g. *Mycobacteria*
  - h. *Spirochaetes*
  - i. *Chlamydia*
  - j. *Mycoplasmatales*; *Mycoplasma*, *Ureaplasma*, *Acholeplasma* and other *Mycoplasmas*.

k. *Rickettsiae, Coxiella, Bartonella* etc.

## **Mycology**

1. Explain general characteristics including morphology, reproduction and classification of fungi
2. Demonstrate knowledge and skills for isolation and identification of fungi
3. Explain tissue reactions to fungi
4. Demonstrate knowledge about epidemiology, morphology, biochemical properties, antigenic nature, pathogenesis, complications, laboratory diagnosis treatment and prevention of major fungal pathogens of medical importance given below-
  - a. Yeasts and yeast like fungi including *Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces* etc.
  - b. Mycelial fungi including *Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra*, other dematiaceous hyphomycetes and other hyalohyphomycetes etc.
  - c. Dimorphic fungi including *Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffeii* etc.
  - d. Dermatophytes
  - e. Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis and Otomycosis.
  - f. *Pneumocystis jirovecii* infection
  - g. *Rhinosporidium seeberi* and *Lacazia loboi* (formerly named *Loboa loboi*)
  - h. *Pythium insidiosum*
  - i. *Prototheca*
5. Able to identify laboratory contaminant fungi
6. Explain Mycetism and mycotoxicosis along with agents involved
7. Demonstrates knowledge about antifungal agents and perform *in vitro* antifungal susceptibility tests.

## **Virology**

1. Demonstrates knowledge about general properties, classification, morphology, virus replication and genetics of viruses
2. Explain pathogenesis of viral infections
3. Demonstrates knowledge about isolation and identification of viruses
4. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of major DNA viruses of medical importance including *Pox viruses*,

*Herpes viruses, Adeno viruses, Hepadna virus, Papova viruses and Parvo viruses* etc.

5. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of major RNA viruses of medical importance including *Enteroviruses, 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.
6. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of major *Hepatitis viruses*
7. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of unclassified viruses and slow viruses including prions
8. Demonstrate knowledge about viral vaccines and anti-viral drugs.

### **Parasitology**

1. Demonstrate knowledge about general characters, classification and methods of identification of parasites.
2. Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of Protozoan parasites of medical importance including *Entamoeba, Free living amoebae, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma, Sarcocystis, Cryptosporidium, Microsporidium, Cyclospora Isospora, Babesia, Balantidium*, etc.
3. Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of helminthes 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 (*Trichiuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus* etc. )
4. Demonstrate knowledge about common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myasis of medical importance.
5. Demonstrate knowledge about anti-parasitic vaccine and drugs.

### **Applied Microbiology**

1. Demonstrate knowledge about epidemiology of infectious diseases
2. Demonstrate knowledge about antimicrobial prophylaxis and therapy



3. Demonstrate knowledge about hospital acquired infections
4. Demonstrate knowledge about management of biomedical waste
5. Effectively investigate an infectious outbreak in hospital and community
6. Demonstrate knowledge about infections of various organs and systems of human body viz. respiratory tract infections, urinary tract infections, central nervous system infections, congenital infections, reproductive tract infections, gastrointestinal infections, hepatitis, pyrexia of unknown origin, infections of eye, ear and nose, septicaemia, endocarditis, haemorrhagic fever etc.
7. Demonstrate knowledge about opportunistic infections
8. Demonstrate knowledge about various sexually transmitted diseases
9. Demonstrate knowledge about principles, methods of preparation, administration and types of vaccines
10. Effectively use information technology (Computers) in microbiology
11. Demonstrate knowledge and applications of Automation in Microbiology
12. Demonstrate knowledge and applications about molecular techniques in the laboratory diagnosis of infectious diseases
13. Demonstrate knowledge in statistical analysis of microbiological data and research methodology
14. Demonstrate knowledge in animal and human ethics involved in microbiology
15. Demonstrate knowledge in safety in laboratory and Laboratory management

**B) Affective Domain:**

1. Should be able to function as a part of a team, develop an attitude of cooperation with colleagues, and interact with the patient and the clinician or other colleagues to provide the best possible diagnosis or opinion.
2. Always adopts ethical principles and maintain proper etiquette in dealings with patients, relatives and other health personnel and to respect the rights of the patient including the right to information and second opinion.
3. Develop communication skills to word reports and professional opinion as well as to interact with patients, relatives, peers and paramedical staff, and students for effective teaching.

**C) Psychomotor domain:**

1. Collection/transportation of specimens for microbiological investigations
2. Preparation, examination and interpretation of direct smears from clinical specimens
3. Plating of clinical specimens on media for isolation, purification, identification and quantification purposes.
4. Preparation of stains viz. Gram, Albert's, Ziehl Neelsen (ZN), Silver impregnation stain and special stains for capsule and spore etc.

5. Preparation and pouring of media like Nutrient agar, Blood Agar, Mac-Conkey agar, Sugars, Kligler iron agar/Triple sugar iron agar (TSI), Robertson's cooked meat broth, Lowenstein Jansens medium, Sabouraud's dextrose agar etc.
6. Preparation of reagents-oxidase, Kovac etc.
7. Quality control of media, reagents etc.
8. Operation of autoclave, hot air oven, filters like Seitz and membrane filters etc
9. Care and operation of microscopes
10. Washing and sterilization of glassware (including plugging and packing)
11. Care, maintenance and use of common laboratory equipments like autoclave, hot air oven, water bath, centrifuge, refrigerators, incubators etc.
12. Aseptic practices in laboratory and safety precautions. Selection of Personal Protective Equipment according to task and donning (gloves, mask, eye protection, gown etc).
13. Sterility tests
14. Identification of bacteria of medical importance up to species level (except anaerobes which could be up to generic level).
15. Techniques of anaerobiosis
16. Tests for Motility: hanging drop, Cragie's tube, dark ground microscopy for *spirochaetes*
17. Routine and Special tests - Catalase test, Oxidase test, slide and tube coagulase tests, niacin and catalase tests for *Mycobacterium*, bile solubility, chick cell agglutination, sheep cell haemolysis, satellitism, CAMP test, and other biochemical tests.
18. Preparation of antibiotic discs; performance of antimicrobial susceptibility testing eg. Kirby-Bauer, Stoke's method, Estimation of Minimal Inhibitory/Bactericidal concentrations by tube/plate dilution methods.
19. Tests for  $\beta$ -lactamase production.
20. Screening of gram negative isolates for ESBL and MBL
21. Screening of *Staphylococci* for Methicillin Resistance.
22. Screening of *Enterococci* for Vancomycin resistance.
23. Testing of disinfectants.
24. Quantitative analysis of urine by pour plate method and semi quantitative analysis by standard loop tests for finding significant bacteriuria
25. Disposal of contaminated materials like cultures
26. Disposal of infectious waste
27. Bacteriological tests for water, air and milk
28. Maintenance and preservation of bacterial cultures

➤ **Time frame to acquire knowledge & skills:**

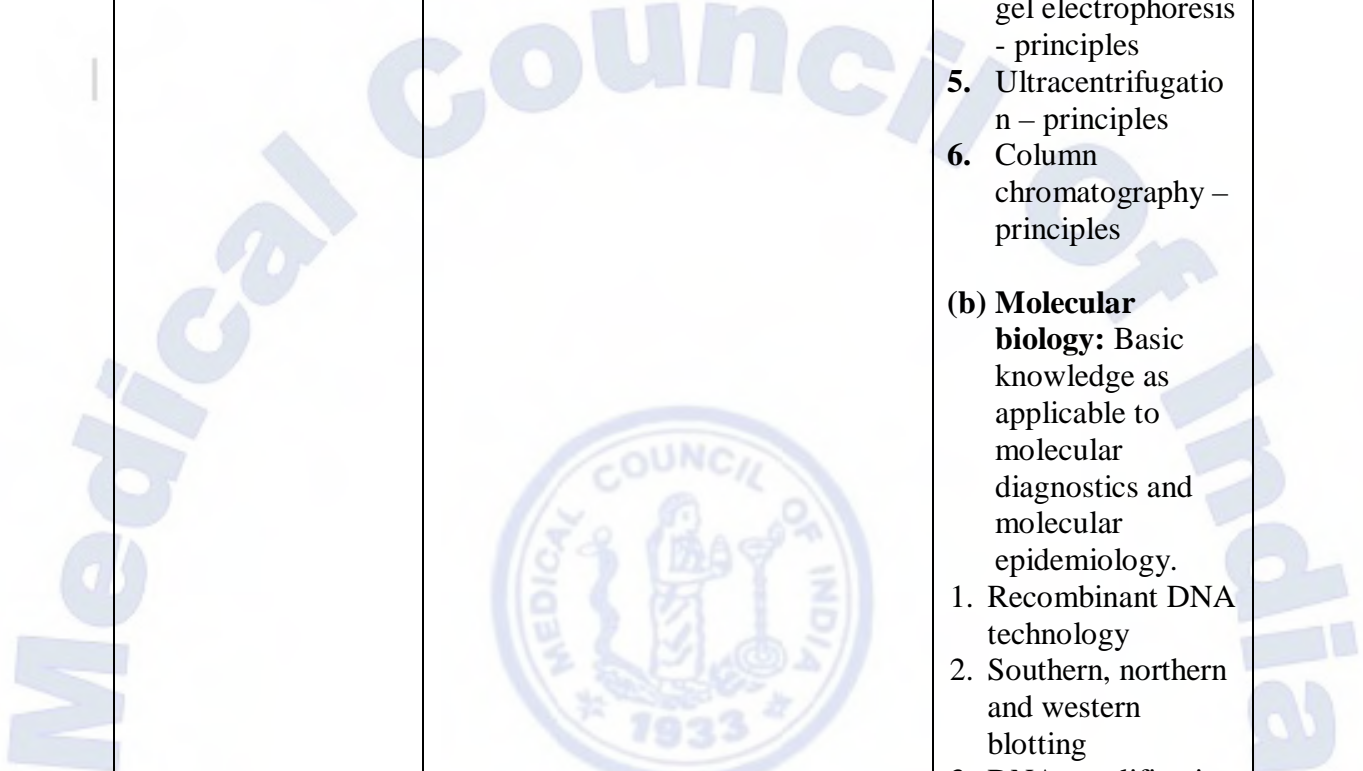

○ **Knowledge :**

End of 1 <sup>st</sup> year	End of 2 <sup>nd</sup> year	End of 3 <sup>rd</sup> year
<b>GENERAL MICROBIOLOGY:</b> 1. History and Pioneers in Microbiology 2. Microscopy 3. Nomenclature and classification of microbes 4. Morphology of bacteria and other micro-organisms 5. Growth and Nutrition of bacteria 6. Bacterial metabolism 7. Sterilization and disinfection 8. Culture media and culture methods 9. Identification of bacteria 10. Bacterial toxins 11. Bacterial antagonism : Bacteriocins 12. Bacterial genetics 13. Gene cloning 14. Antibacterial substances used in the treatment of infections and drug resistance in bacteria 15. Bacterial ecology - Normal flora of human body, Hospital environment, Air, Water and Milk 16. Host-parasite relationship	<b>IMMUNOLOGY :Clinical</b> 1. Hypersensitivity 2. Immunodeficiency 3. Auto-immunity 4. Immune tolerance 5. Transplantation immunity 6. Tumour immunity 7. Immunoprophylaxis and immunotherapy 8. Measurement of immunity	<b>GENERAL MICROBIOLOGY &amp; IMMUNOLOGY:</b>  <b>All</b>
<b>IMMUNOLOGY :</b> 1. Innate and acquired immunity 2. Antigens 3. Immunoglobulins 4. Antigen and antibody Reactions 5. Complement System 6. The normal immune system: structure and function 7. Immune Response	<b>SYSTEMATIC BACTERIOLOGY</b> 1. <i>Streptococcus and Lactobacillus</i> 2. <i>Staphylococcus and Micrococcus</i> 3. <i>Pseudomonas</i> 4. <i>The Enterobacteriaceae</i> 5. <i>Mycobacteria</i> 6. <i>Corynebacterium</i> and other Coryneform bacteria 7. <i>Vibrios, Aeromonas, Plesiomonas, Campylobacter &amp; Spirillum</i> 8. <i>Neisseria, Branhamella &amp; Moraxella</i> 9. <i>Haemophilus and Bordetella</i> 10. <i>Bacillus</i> : the aerobic spore-	<b>SYSTEMATIC BACTERIOLOGY (2<sup>nd</sup> year) :</b> <b>plus</b> 1. <i>Actinomycetes, Nocardia and Actinobacillus</i> 2. <i>Erysipelothrix and Listeria</i> 3. The <i>Bacteroidaceae: Bacteroides, Fusobacterium and Leptotrichia</i> 4. <i>Chromobacterium, flavobacterium, Acinetobacter and</i>

	bearing bacilli 11. <i>Clostridium</i> : the spore-bearing anaerobic bacilli 12. Non-sporing anaerobe 13. The <i>Spirochaetes</i>	<i>Alkaligenes</i> 5. <i>Pasteurella</i> , <i>Francisella</i> 6. <i>Brucella</i> 7. <i>Chlamydia</i> 8. <i>Rickettsiae</i> 9. <i>Mycoplasmatales</i> : <i>Mycoplasma</i> , <i>Ureaplasma</i> and <i>Acholeplasma</i> 10. Miscellaneous bacteria
<b>MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES</b>  1. Normal Microbial flora 2. Epidemiology of infectious diseases 3. Hospital acquired infections & Hospital waste disposal 4. Bacteriology of water milk and air	<b>VIROLOGY:</b> 1. The nature of viruses 2. Classification of viruses 3. Morphology: virus structure 4. Virus replication 5. The genetics of viruses 6. The pathogenicity & lab diagnosis of viruses 7. Epidemiology of viral infections 8. Anti-viral drugs 9. Bacteriophages 10. <i>Herpes viruses</i> 11. <i>Paramyxoviruses</i> 12. <i>Influenza virus</i> 13. <i>Hepatitis viruses</i> 14. <i>Rabies virus</i> 15. <i>Human immunodeficiency viruses</i>	<b>VIROLOGY (2<sup>nd</sup> year): plus</b> 1. Vaccines 2. <i>Pox viruses</i> 3. <i>Vesicular viruses</i> 4. <i>Toga viruses</i> 5. <i>Bunya viruses</i> 6. <i>Arena viruses</i> 7. <i>Marburg and Ebola viruses</i> 8. <i>Rubella virus</i> 9. <i>Orbi viruses</i> 10. Respiratory diseases : <i>Rhinoviruses</i> , <i>adenoviruses</i> and <i>corona viruses</i> 11. Enteroviruses; <i>Polio</i> , <i>Echo</i> , and <i>Coxsackie viruses</i> 12. Other enteric viruses 13. Slow viruses 14. Oncogenic viruses 15. Teratogenic viruses
	<b>PARASITOLOGY:</b> 1. General Parasitology 2. <b>Protozoan parasites of medical importance:</b> <i>Entamoeba</i> , <i>Giardia</i> , <i>Trichomonas</i> , <i>Leishmania</i> , <i>Trypanosoma</i> , <i>Plasmodium</i>	<b>PARASITOLOGY (2<sup>nd</sup> year): plus</b> 1. <b>Protozoan parasites of medical importance:</b> <i>Toxoplasma</i> , <i>Sarcocystis</i> , <i>Cryptosporidium</i> , <i>Babesia</i> , <i>Balantidium</i> etc. 2. <b>Helminthology:</b> All those medically important helminthes belonging to Cestoda, Trematoda and Nematoda. 3. <b>Cestodes:</b> <i>Diphyllobothrium</i> , <i>Taenia</i> , <i>Echinococcus</i> , <i>Hymenolepis</i> , <i>Dipylidium</i> ,



		<p><i>Multiceps</i> etc.</p> <p><b>4. Trematodes:</b> <i>Schistosomes,</i> <i>Fasciola,</i> <i>Gastrodiscoides,</i> <i>Paragonimus,</i> <i>Clonorchis,</i> <i>Opisthorchis</i> etc.</p> <p><b>5. Nematodes:</b> <i>Trichuris,</i> <i>Trichinella,</i> <i>Strongyloides,</i> <i>Ancylostoma,</i> <i>Necator, Ascaris,</i> <i>Toxocara,</i> <i>Enterobius,</i> <i>Filarial worms,</i> <i>Dracunculus,</i> etc.</p> <p><b>6. Ecto-parasites:</b> Common arthropods and other vectors viz., Mosquito, Sand fly, Ticks, Mite, Cyclops</p>
	<p><b>MYCOLOGY</b></p> <p>1. The morphology and reproduction in fungi</p> <p>2. Classification of fungi</p> <p>3. <i>Dermatophytes</i></p> <p>4. <i>Candida</i></p> <p>5. <i>Aspergillus</i></p>	<p><b>MYCOLOGY (2<sup>nd</sup> year): plus</b></p> <p>1. Contaminant and opportunistic fungi</p> <p>2. Fungi causing superficial mycoses</p> <p>3. Fungi causing subcutaneous mycoses</p> <p>4. Fungi causing systemic infections</p> <p>5. Anti-mycotic agents</p>
		<p><b>MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES</b></p> <p>1. Infections of various organs and systems of human body</p> <p>2. Molecular genetics as applicable to microbiology</p> <p>3. Vaccinology: principle, methods of preparation, administration of vaccines.</p> <p>4. Bio-terrorism</p> <p><b>ALLIED BASIC SCIENCES</b></p>

	 	<p><b>(a) Biochemistry:</b>  Basic understanding of biochemistry as applied to immunological/ molecular methods for study of microbial diseases and pathogenesis of infections.</p> <ol style="list-style-type: none"> <li>1. Protein purification and estimation</li> <li>2. Protein estimation</li> <li>3. Nucleic acid purification and characterization</li> <li>4. Agarose and polyacrylamide gel electrophoresis - principles</li> <li>5. Ultracentrifugation – principles</li> <li>6. Column chromatography – principles</li> </ol> <p><b>(b) Molecular biology:</b> Basic knowledge as applicable to molecular diagnostics and molecular epidemiology.</p> <ol style="list-style-type: none"> <li>1. Recombinant DNA technology</li> <li>2. Southern, northern and western blotting</li> <li>3. DNA amplification techniques</li> <li>4. Diagnostic PCR, different methods of PCR product detection (liquid hybridization, ELISA).</li> <li>5. Genotyping of microbes and viruses</li> </ol> <p><b>(c) Pathology: (as applied to Microbiology)</b>  Basic knowledge of</p> <ol style="list-style-type: none"> <li>1. Inflammation and repair</li> <li>2. Intercellular substances and</li> </ol>
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		reaction 3. Pathological changes in the body in bacterial, viral, mycotic and parasitic infections 4. Demonstration of pathogen in tissue section
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○ **Skills:**

<b>1<sup>st</sup> year residency-skills list</b>					
Area	Sr. no.	Procedure	Observed no.	Assisted no./ practice on dummy	Performed independently no.(under supervision)
General microbiology	1.	Microscopy for unstained preparations/ wet mount	5	5	10
	2.	Microscopy for stained preparation	5	5	10
	3.	Preparation of direct smears from clinical specimens	5	5	10
	4.	Hanging drop preparation	5	5	10
	5.	Washing, sterilization and packing of glassware	10 sessions	-	-
	6.	Infection control activities-environmental sampling	10	10	-
	7	Identification of HAI	5	5	--
	8	Calculation of HAI quality indicators	5	5	--
	9	Bacteriology of water	5	5	-
	10	Bacteriology of air	5	5	-
	11	Antibiotic disc preparation	-	-	-
	12	Handling of laboratory animal	-	-	-
	13	Methods for preservation of bacteria	10	-	-
	14	Maintenance of stock cultures	10	-	-
Staining	1	Gram staining	10	20	30
	2	Acid fast staining ( Ziehl-Neelsen method)	10	20	30
	3	Albert staining	5	10	10
	4	Modified ZN staining for <i>M. leprae</i>	5	5	5
	5	Modified ZN staining for <i>Nocardia</i>	5	5	5
	6	IQC-staining	5	5	5
Media preparation	1	Preparation of stains	4	4	4
	2	Preparation of reagents	10	10	10
	3	Preparation, plugging, pouring	20	20	30

		& Quality Control (QC) of culture media			
	4	Operation & maintenance of autoclave	10	10	20
Bacteriology	1	Specimen collection for Blood Culture	5	5	5
	2	Inoculation of liquid & solid media	20	20	30
	3	Identification test	20	20	30
	4	Antimicrobial sensitivity testing- modified Kirby-bauer technique	10	20	30
	5	IQC- Antibiotic disc potency	5	5	-
	6	Operation of BacT/ALERT	5	10	20
	7	Operation of Vitek 2 compact	5	10	20
	8	Petroff's concentration technique	10	10	20
	9	AFB culture & sensitivity	5	10	20
Mycology	1	KOH Wet mount	5	10	20
	2	Germ tube test	5	10	20
	3	Slide culture	5	10	20
	4	Negative staining for fungus	5	5	5
	5	LPCB mount	10	10	10
Parasitology	1	Giemsa staining for thick & thin peripheral blood smear	5	-	-
	2	Stool wet mount for R/M	10	20	30
	3	Stool concentration techniques	5	10	5
	4	Modified ZN staining for <i>C. parvum</i>	2	2	2
Serology/ Immunology	1	Phlebotomy & separation of serum	10	10	5
	2	Operation & maintenance of mini-VIDAS	5	10	20
	3	Operation & maintenance of ELISA reader & washer	5	10	--
		<b>Performance of serological tests</b>			
	1	Latex agglutination test(RA, ASO)	10	20	30
	2	RPR card test	10	20	30
	3	Tube agglutination test	10	20	30
	4	Gold conjugate Rapid card test	10	20	30
	5	ANA by IF	5	5	--
	6	ANA by Immunoblot	5	5	--
	7	IQC-serology	5	5	5

<b>2<sup>nd</sup> year residency-skill list</b>					
Area	Sr. no.	Procedure	Observed no.	Assisted no./ practice on dummy	Performed independently no. (under supervision)
General microbiology	1.	Microscopy for unstained preparations/ wet mount	---	--	--
	2.	Microscopy for stained preparation	--	--	--
	3.	Preparation of direct smears from clinical specimens	--	--	--
	4.	Preparation of slit skin smear for lepra bacilli	5	5	5
	5.	Hanging drop preparation	--	--	10
	6.	Washing, sterilization and packing of glassware	05 sessions	-	-
	7	Infection control activities- environmental sampling	--	10	10
	8	Identification of HAI	--	5	5
	9	Calculation of HAI quality indicators	--	5	5
	10	Bacteriology of water	--	5	5
	11	Bacteriology of air	--	5	5
	12	Antibiotic disc preparation	05 lots	-	-
	13	Handling of laboratory animal	-	-	-
	14	Methods for preservation of bacteria	--	05	10
	15	Maintenance of stock cultures	--	05	10
Staining	1	Gram staining	--	--	30
	2	Acid fast staining ( Ziehl-Neelsen method)	--	--	30
	3	Albert staining	--	--	05
	4	Modified ZN staining for <i>M. leprae</i>	--	--	5
	5	Modified ZN staining for <i>Nocardia</i>	--	--	5
	6	IQC-staining	--	--	5
Media preparation	1	Preparation of stains	--	--	5
	2	Preparation of reagents	--	--	15
	3	Preparation, plugging, pouring & Quality Control (QC) of culture media	--	--	50
	4	Operation & maintenance of autoclave	--	--	20
Bacteriology	1	Specimen collection for Blood Culture	--	--	5
	2	Inoculation of liquid & solid media	--	--	30
	3	Identification test	--	--	30
	4	Antimicrobial sensitivity testing- modified Kirby-bauer technique	--	--	30
	5	IQC- Antibiotic disc potency	--	5	5
	6	Operation of BacT/ALERT	--	--	20
	7	Operation of Vitek 2 compact	--	--	20
	8	Petroff's concentration technique	--	--	20
	9	AFB culture & sensitivity	--	--	20
Mycology	1	KOH Wet mount	--	--	20



	2	Germ tube test	--	--	20
	3	Slide culture	--	--	20
	4	Negative staining for fungus	--	--	5
	5	LPCB mount	--	--	10
Parasitology	1	Giemsa staining for thick & thin peripheral blood smear	-	10	-
	2	Stool wet mount for R/M	--	--	30
	3	Stool concentration techniques	--	--	5
	4	Modified ZN staining for <i>C. parvum</i>	--	--	2
Serology/ Immunology	1	Phlebotomy & separation of serum	--	--	5
	2	Operation & maintenance of mini-VIDAS	--	--	20
	3	Operation & maintenance of ELISA reader & washer	--	--	20
		<b>Performance of serological tests</b>			
	1	Latex agglutination test(RA, ASO, CRP)	--	--	30
	2	RPR card test	--	--	30
	3	Tube agglutination test	--	--	30
	4	Gold conjugate rapid card test	--	--	30
	5	ANA by IF	--	--	10
	6	ANA by Immunoblot	--	--	10
	7	IQC-serology	--	--	5

<b>3<sup>rd</sup> year residency-skill list</b>					
Area	Sr. no.	Procedure	Observed no.	Assisted no./ practice on dummy	Performed independently no. (under supervision)
General microbiology	1.	Microscopy for unstained preparations/ wet mount	---	--	--
	2.	Microscopy for stained preparation	--	--	--
	3.	Preparation of slit skin smear for lepra bacilli	--	--	--
	4.	Hanging drop preparation	--	--	--
	5.	Washing, sterilization and packing of glassware	05 sessions	-	-
	6.	Infection control activities-environmental sampling	--	--	10
	7	Identification of HAI	--	--	5
	8	Calculation of HAI quality indicators	--	--	5
	9	Bacteriology of water	-	-	5
	10	Bacteriology of air	-	-	5
	11	Antibiotic disc preparation	-	5 lots	2 lots
	12	Handling of laboratory animal	-	-	10
	13	Methods for preservation of bacteria	-	-	10

	14	Maintenance of stock cultures	-	-	10
Staining	1	Gram staining	--	--	30
	2	Acid fast staining ( Ziehl-Neelsen method)	--	--	30
	3	Albert staining	--	--	05
	4	Modified ZN staining for <i>M. leprae</i>	--	--	5
	5	Modified ZN staining for <i>Nocardia</i>	--	--	5
	6	IQC-staining	--	--	5
Media preparation	1	Preparation of stains	--	--	10
	2	Preparation of reagents	--	--	15
	3	Preparation, pouring & Quality Control (QC) of culture media	--	--	50
	4	Operation & maintenance of autoclave	--	--	20
Bacteriology	1	Specimen collection for Blood Culture	--	--	5
	2	Inoculation of liquid & solid media	--	--	30
	3	Identification test	--	--	30
	4	Antimicrobial sensitivity testing- modified Kirby-bauer technique	--	--	30
	5	IQC- Antibiotic disc potency	--	--	5
	6	Operation of BacT/ALERT	--	--	20
	7	Operation of Vitek 2 compact	--	--	20
	8	Petroff's concentration technique	--	--	20
	9	AFB culture & sensitivity	--	--	20
Mycology	1	KOH Wet mount	--	--	20
	2	Germ tube test	--	--	20
	3	Slide culture	---	---	20
	4	Negative staining for fungus	--	--	5
	5	LPCB mount	--	--	10
Parasitology	1	Giemsa staining for thick & thin peripheral blood smear	--	--	-
	2	Stool wet mount for R/M	--	--	30
	3	Stool concentration techniques	--	--	5
	4	Modified ZN staining for <i>C. parvum</i>	--	--	2
Serology/ Immunology	1	Phlebotomy & separation of serum	--	--	5
	2	Operation & maintenance of mini-VIDAS	--	--	20

	3	Operation & maintenance of ELISA reader & washer	--	--	20
		<b>Performance of serological tests</b>			
	1	Latex agglutination test(RA, ASO, CRP)	--	--	30
	2	RPR card test	--	--	30
	3	Tube agglutination test	--	--	30
	4	Gold conjugate rapid card test	--	--	30
	5	ANA by IF	--	--	10
	6	ANA by Immunoblot	--	--	10
	7	IQC-serology	--	--	5

## *Syllabus*

### Course contents:

#### Paper I: General Microbiology

1. History of microbiology
2. Microscopy
3. Bio-safety including universal containment, personal protective equipment for biological agents
4. Physical and biological containment
5. Isolation precautions including standard precautions and transmission based precautions
6. Sterilization, disinfection and lyophilization
7. Morphology of bacteria and other microorganisms
8. Nomenclature and classification of microorganisms
9. Normal flora of human body
10. Growth and nutrition of bacteria
11. Bacterial metabolism
12. Bacterial toxins
13. Bacteriocins
14. Microbiology of hospital environment
15. Microbiology of air, milk and water
16. Host-parasite relationship
17. Antimicrobial agents and mechanisms drug resistance
18. Bacterial genetics and bacteriophages
19. Molecular genetics relevant for medical microbiology
20. Quality assurance and quality control in microbiology
21. Accreditation of laboratories



## Immunology

1. Components of immune system
2. Innate and acquired immunity
3. Cells involved in immune response
4. Antigens
5. Immunoglobulins
6. Mucosal immunity
7. Complement
8. Antigen and antibody reactions
9. Hypersensitivity
10. Cell mediated immunity
11. Cytokines
12. Immunodeficiency
13. Auto-immunity
14. Immune tolerance
15. MHC complex
16. Transplantation immunity
17. Tumor immunity
18. Vaccines and immunotherapy
19. Measurement of immunological parameters
20. Immunological techniques
21. Immunopotential and immunomodulation

## Paper II: Systematic bacteriology

1. Isolation and identification of bacteria
2. Gram positive cocci of medical importance including *Staphylococcus*, *Micrococcus*, *Streptococcus*, *anaerobic cocci* etc.
3. Gram negative cocci of medical importance including *Neisseria*, *Branhamella*, *Moraxella* etc.
4. 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.
5. Gram negative bacilli of medical importance including *Vibrios*, *Aeromonas*, *Plesiomonas*, *Haemophilus*, *Bordetella*, *Brucella*, *Gardnerella*, *Pseudomonas and other non-fermenters*, *Pasteurella*, *Francisella*, *Bacteroides*, *Fusobacterium*, *Leptotrichia and other anaerobic gram negative bacilli* etc.
6. *Helicobacter*, *Campylobacter*, *Calymmatobacterium*, *Streptobacillus*, *Spirillum* and miscellaneous bacteria
7. *Enterobacteriaceae*

8. *Mycobacteria*
9. *Spirochaetes*
10. *Chlamydia*
11. *Mycoplasmatales; Mycoplasma, Ureaplasma, Acholeplasma and other Mycoplasmas.*
12. *Rickettsiae, Coxiella, Bartonella etc.*

### **Mycology**

1. General characteristics and classification of fungi
2. Morphology and reproduction of fungi
3. Isolation and identification of fungi
4. Tissue reactions to fungi
5. Yeasts and yeast like fungi of medical importance including *Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces* etc.
6. Mycelial fungi of medical importance including *Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra, other dematiaceous hyphomycetes and other hyalohyphomycetes* etc.
7. Dimorphic fungi including *Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffeii* etc.
8. *Dermatophytes*
9. Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis and Otomycosis.
10. *Pythium insidiosum*
11. *Prototheca*
12. *Pneumocystis jirovecii* infection
13. *Rhinosporidium seeberi and Lacazia loboi (Loboa loboi)*
14. Laboratory contaminant fungi
15. Mycetism and mycotoxicosis
16. Antifungal agents and *in vitro* antifungal susceptibility tests.

### **Paper III: Virology**

1. General properties of viruses
2. Classification of viruses
3. Morphology: Virus structure
4. Virus replication
5. Isolation and identification of viruses
6. Pathogenesis of viral infections
7. Genetics of viruses
8. DNA viruses of medical importance including Pox viruses, Herpes viruses, Adeno viruses, Hepadna virus, Papova and Parvo viruses etc.
9. RNA viruses of medical importance including Enteroviruses, 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.
10. Slow viruses including prions
  11. Unclassified viruses
  12. Hepatitis viruses
  13. Virioids, prions
  14. Vaccines and anti-viral drugs.

### **Parasitology**

1. General characters and classification of parasites.
2. Methods of identification of parasites
3. Protozoan parasites of medical importance including *Entamoeba*, *Free living amoebae*, *Giardia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Toxoplasma*, *Sarcocystis*, *Cryptosporidium*, *Microsporidium*, *Cyclospora*, *Isospora*, *Babesia*, *Balantidium*, etc.
4. Helminthology 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 (etc.)
5. Entomology: common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myasis.
6. Anti-parasitic agents.

### **Paper IV: Applied Microbiology**

1. Epidemiology of infectious diseases
2. Antimicrobial prophylaxis and therapy
3. Hospital acquired infections
4. Management of biomedical waste
5. Investigation of an infectious outbreak in hospital and community
6. Infections of various organs and systems of human body viz. respiratory tract infections, urinary tract infections, central nervous system infections, congenital infections, reproductive tract infections, gastrointestinal infections, hepatitis, pyrexia of unknown origin, infections of eye, ear and nose, septicaemia, endocarditis, haemorrhagic fever etc.
7. Opportunistic infections
8. Sexually transmitted diseases
9. Vaccinology: principles, methods of preparation, administration of vaccines, types of vaccines
10. Information technology (Computers) in microbiology
11. Automation in Microbiology
12. Molecular techniques in the laboratory diagnosis of infectious diseases

13. Statistical analysis of microbiological data and research methodology
14. Animal and human ethics involved in microbiological work.
15. Safety in laboratory and Laboratory management

## ***TEACHING AND LEARNING METHODS***

The training programme should be designed to enable the student to acquire a capacity to learn and investigate, to synthesize and integrate a set of facts and develop a faculty to reason. The curricular programme and scheduling of postings must provide the student with opportunities to achieve the above broad objectives. Much of the learning is to be accomplished by the student himself. Interactive discussions are to be preferred over didactic sessions. The student must blend as an integral part of the activities of an academic department that usually revolves around three equally important basic functions of teaching, research and service. As mentioned earlier, the emphasis recommended under a residency programme is of learning while serving/working.

### **Post Graduate Training programme**

#### **Teaching methodology**

Based on the available facilities, the Department can prepare a list of post graduate experiments pertaining to basic and applied microbiology. Active learning should form the mainstay of post graduate training; there should be lectures for post graduates (at least 20 per year), along with seminars, symposia, group-discussions and Journal clubs. The post graduate students should regularly do the ward rounds of various clinical departments and learn cases of interest for discussion with the clinical faculty. Each college should have a Medical Education Unit to generate teaching resource material for undergraduates and evolving of problem solving modules.

#### **Rotation:**

#### **Postings to laboratories/assignments**

The three-year training programme for the MD degree may be arranged in the form of postings to different assignments/laboratories for specified periods as outlined below. The period of such assignments/postings is recommended for 35 months. Posting schedules may be modified depending on needs, feasibility and exigencies. For facilities not available in the parent institution as well as for additional knowledge and skill, extramural postings may be undertaken.

#### **Suggested schedule of rotation:**

##### **Within Department**

1. Bacteriology
2. Mycobacteriology
3. Serology/Immunology



4. Mycology
5. Virology
6. Parasitology
7. Media preparation

#### **Other Departments**

1. Clinical Pathology
2. Clinical Biochemistry
3. Skin & VD
4. ICTC & RNTCP

#### **Practical training**

Practical training should be imparted by posting the students in various sub-specialties (sections) as detailed in the intrinsic and extrinsic rotation. The student should be actively involved in day to day working of all the sections. He/she should be trained under the guidance of teachers in all the aspects of Clinical Microbiology and applied aspects of laboratory medicine including collection and transport of specimens, receiving of samples, preparation of requisite reagents, chemicals, media and glassware, processing of specimens, performing required antimicrobial susceptibility testing and reporting on the specimens, interpretation of results, sterilization procedures, bio-safety precautions, infection control practices, maintenance of equipments, record keeping and quality control in Microbiology.

#### **Skills & performance**

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

#### **Emergency duty**

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

#### **Training in research methodology**

Training in research methodology should be imparted by planning of a research project by the student under the guidance of a recognized guide to be executed and submitted in the form of a thesis.

The thesis is aimed at training the post graduate student in research methods and techniques. It should include identification of a research question, formulation of a hypothesis, search and review of relevant literature, getting acquainted with recent

advances, designing of research study, collection of data, critical analysis of the results and drawing conclusions. The thesis should be completed and submitted by the student six months before appearing for the final university examination.

### **Communication and attitudinal skills**

Post-graduate student is expected to imbibe professional attributes of honesty, integrity, accountability, honour, humanism and excellence and demonstrate the same in the day-by-day conduct and dealings with the teacher, peers, the nursing and paramedical staff and most-importantly patients. To ensure that student is able to acquire these attributes, their personal conduct should be keenly observed by the teachers and student should be counselled as and when required. Personal attributes of the student should be regularly assessed by peers, senior, and junior students and Head of the Unit/ In charge.

The following is a rough guideline to various teaching/learning activities that may be employed.

- Collection of specimens, smear examination, culture and sensitivity analysis
- Discussion during routine activities such as during signing out of cases.
- Presentation and work-up of cases including the identification of special stains and ancillary procedures needed.
- Clinico-microbiological conferences, active involvement with hospital infection control committee
- Intradepartmental and interdepartmental conferences related to case discussions.
- Conferences, Seminars, Continuing Medical Education (CME) Programme.
- Journal Club.
- Research Presentation and review of research work.
- A postgraduate student of a postgraduate degree course in broad specialties/super specialties would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.
- Participation in workshops, conferences and presentation of papers etc.
- Laboratory work.
- Use and maintenance of equipment.
- Maintenance of records. **Log books** should be maintained to record the work done which shall be checked and assessed periodically by the faculty members imparting the training.
- Postgraduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.
- Department should encourage e-learning activities.

During the training programme, patient safety is of paramount importance, therefore, skills are to be learnt initially on the models, later to be performed under supervision followed by performing independently; for this purpose, provision of skills laboratories in medical colleges is mandatory.

## **ASSESSMENT**

### **FORMATIVE ASSESSMENT, i.e., assessment during the training**

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

#### **General Principles**

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

#### **Quarterly assessment during the MD programme should be based on:**

- 1. Journal based / recent advances learning**
- 2. Patient based /Laboratory or Skill based learning**
- 3. Self directed learning and teaching**
- 4. Departmental and interdepartmental learning activity**
- 5. External and Outreach Activities / CMEs**

The student to be assessed periodically as per categories listed in postgraduate student appraisal form (Annexure I).

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

The summative examination would be carried out as per the Rules given in **POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.**

The post-graduate examinations should be in three parts:

#### **1. Thesis.**

Every post graduate student shall carry out work on an assigned research project under the guidance of a recognized Post Graduate Teacher, the result of which shall be written up and submitted in the form of a Thesis. Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the

post graduate student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature.

Thesis shall be submitted at least six months before the Theory and Clinical / 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 Clinical examination. A post graduate student shall be allowed to appear for the Theory and Practical/Clinical 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 post graduate student's level of knowledge, skill and competence at the end of the training. 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./ MS shall be held at the end of 3rd academic year. An academic term shall mean six month's training period.

There should be four theory papers:

<b>Paper I:</b>	General Microbiology and Immunology
<b>Paper II:</b>	Systematic Bacteriology
<b>Paper III:</b>	Virology Parasitology and Mycology
<b>Paper IV:</b>	Applied Microbiology and Recent advances

## 3. Practical and Oral/viva voce Examination

Practical should be spread over **two** days and include the following components:

- **Bacteriology:**

1. Identification of a pure culture.
2. Isolation and Identification of Bacteria from Clinical Samples

- **Serology:**

Common Serological Tests like ELISA/VDRL/Widal/Brucella Agglutination test etc.

- **Virology:**

1. Preparation of tissue cultures
2. Virus Titration
3. Haemagglutination and its inhibition test
4. Virus Neutralization Test
5. Other rapid tests for diagnosis of viral infections



- **Mycology**
  1. Identification of fungal cultures
  2. Slide culture techniques
  3. Examination of histopathology slides for fungi
  
- **Parasitology**
  1. Processing and Identification of ova and cysts in stool samples
  2. Amoebic Serology
  3. Microscopic Slides
  4. Examination of histopathology slides for parasites
  5. Spots: 10 spots

**Oral/Viva-Voce Examination:**

This must include a component of teaching session of not more than 15 minutes duration.

**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, Tenover FC, Tenover FC, Tenover FC, 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. Wiedbrauk DL, Johnston SLG. *Manual of Clinical Virology*, New York, Raven Press.
6. Bailey and Scott's Diagnostic Microbiology.

**Journals**

03-05 international Journals and 02 national (all indexed) journals

**Postgraduate Students Appraisal Form**  
Pre / Para /Clinical Disciplines

Name of the Department/Unit :

Name of the PG Student :

Period of Training : FROM.....TO.....

Sr. No.	PARTICULARS	Not Satisfactory			Satisfactory			More Than Satisfactory			Remarks
		1	2	3	4	5	6	7	8	9	
1.	Journal based / recent advances learning										
2.	Patient based /Laboratory or Skill based learning										
3.	Self directed learning and teaching										
4.	Departmental and interdepartmental learning activity										
5.	External and Outreach Activities / CMEs										
6.	Thesis / Research work										
7.	Log Book Maintenance										

Publications

Yes/ No

Remarks\*

\*REMARKS: Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.

SIGNATURE OF ASSESSEE

SIGNATURE OF CONSULTANT

SIGNATURE OF HOD