

SRI BALAJI VIDYAPEETH

(Deemed - to be - University u/s 3 of UGC Act, 1956)

Pillaiyarkuppam, Puducherry – 607 402

Mahatma Gandhi Medical College and Research Institute

Shri Sathya Sai Medical College and Research Institute



COMPETENCY BASED POSTGRADUATE MEDICAL CURRICULUM M.D. MICROBIOLOGY (2020 Onwards)

(As approved at the 30th Academic Council Meeting held on 28th September 2020)

Preface

Following the promulgation of the much awaited Competency Based Medical Education (CBME) for post graduate by the Medical Council of India (MCI) (superseded by the Board of Governors), adoption of CBME for implementing post-graduate programs is a welcome move. Sri Balaji Vidyapeeth (SBV), Puducherry, Deemed to be University, declared u/s 3 of the UGC Act. and accredited by the NAAC with A grade, takes immense privilege in preparing such an unique document in a comprehensive manner and most importantly the onus is on the Indian setting for the first time with regard to the competency based medical education for post graduate programs that are being offered in the broad specialty departments. SBV is committed to making cardinal contributions that would be relaised by exploring newer vistas. Thus, post graduate medical education in the country could be made to scale greater heights and SBV is poised to show the way in this direction.

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Preface

Following roll out of much awaited Competency-Based Medical Education (CBME) for undergraduate by the Medical Council of India (MCI)(superseded by the Board of Governors) , adoption of CBME for post-graduate by it is welcome move.

The MCI has laid down the syllabus course wise, listing competency to some extent, teaching learning methods and the assessment methods as well. The MCI describes competencies in three domains (knowledge, skill, and attitude). However, the most significant problem in competency-based training is the development of appropriate assessment tools.

The salient feature of this document is defining the program educational objectives (PEO) for its postgraduate program as a whole, defining program outcomes (PO) based on the competencies to be practiced by the specialist, course outcomes (CO) and program specific sub-competencies and their progression in the form of milestones. The compilation of the milestone description leads to the formation of the required syllabus. This allows the mentors to monitor the progress in sub-competency milestone levels. It also defines milestone in five levels, for each sub-competency. Although MCI has described three domains of competencies, the domain 'Attitude' is elaborated into 4 more competencies for ease of assessment. The six competency model (ACGME) for residency education: Medical Knowledge, Patient Care, Practice Based Learning and Improvement, Systems Based Practice, Professionalism, Inter personal and Communication Skills gives better clarity and in-depth explanation. The sub-competency and their milestone levels are mapped into the entrustable professional activities (EPA) that are specific to the individual postgraduate program. To make the program more relevant, PEO, PO, CO and EPAs are mapped with each other. EPA's which are activity based are used for formative assessment and graded. EPA assessment is based on workplace based assessment (WPBA), multisource feedback (MSF) and eportfolio. A great emphasis is given on monitoring the progress in acquisition of knowledge, skill and attitude through various appraisal forms including e-portfolios during three years of residency period.



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Foreword

We believe deeply in the educative value of imparting quality knowledge for all students, especially in a profession where patient care cannot be compromised. There is a strong demand for the competency based postgraduate course curriculum for Indian Medical Graduates to which we have professionally catered.

Perusing this booklet, the reader will find it hard to defend the view that good students are born, not made. Attitude development strategies inculcate good attitude in students which is the foundation for knowledge and skill development. And what better way to strengthen the quality of teaching and learning in our medical colleges?

The team at SBV, pursued and distinctively achieved in publishing this document which elaborates the program educational objectives and outcome, and detailing entrustable professional activities linked with competencies. This facilitates a medical postgraduate to comprehensibly understand about the course mechanism and what are the outcomes expected for successful completion of the program.

The document guides the postgraduate in training to understand the real – world clinical application of microbiology systematically. It also guides the postgraduate on how to assimilate latest scientific information including recent advance in diagnostic microbiology and research methodology.

This course booklet helps the postgraduate to make independent decisions in routine diagnostic bacteriology, parasitology, mycology, virology and immunology.

We really appreciate the efforts made by the entire team for this esteemable work. This would be of most benefit to postgraduate and as well be a quantum leap in compassionate and safe patient care.

Best wishes to the entire team Team Microbiology
SBVU

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Table of Contents

1. Preamble.....	1
2. Program Educational Objectives (PEO):.....	1
3. Program Outcome (PO).....	2
4. Course and Course Objectives (CO)	3
4.1 Course 1 (C1): General Microbiology& Immunology.....	3
4.2 Course 2 (C2): Systematic Bacteriology	4
4.3 Course 3 (C3): Virology, Mycology & Parasitology	4
4.4 Course 4 (C4): Applied microbiology and Recent advances.....	5
5. Mapping of PEO, PO and CO	6
5.1 Competencies, Sub-competencies and Milestone	7
6. Syllabus	21
6.1 Course 1: General Microbiology& Immunology	21
6.2 Course 2: Systematic Bacteriology	22
6.3 Course 3 (C3): Virology, Mycology & Parasitology	23
6.4 Course 4 (C4): Applied microbiology and Recent advances	25
7. Teaching/Learning Methods	27
8. Assessment.....	41
8.1 Formative Assessment	41
8.2 Summative Assessment.....	76
9. Blue print of Weight of the system	78
10. Model Question Paper for MD Microbiology.....	80
11. Recommended Reading.....	84
12. Annexures.....	86

This document named postgraduate curriculum for the **MD MICROBIOLOGY** has been prepared in the accordance with the document notified by Board of Governors in suppression of MCI <https://www.mciindia.org/CMS/information-desk/for-colleges/pg-curricula-2>. This document has been prepared by the Department of Microbiology, MGMCRI, Puducherry, ratified by the Board of Studies and approved by Academic Council of Sri Balaji Vidyapeeth, a deemed to be university, accredited 'A' Grade by NAAC.

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Sri Balaji University
Department of Microbiology
Post- Graduate Program

1. Preamble

The competency based curriculum should take into account the needs of the society, both local and global. It needs to outline the demand for the present day as well as future. The curriculum needs to be reviewed at least every five years to address the trending needs.

The main aim of this course is to train students of Medicine in the field of Medical Microbiology. Theoretical and practical training is imparted to the candidates in subspecialties viz., Bacteriology, Virology, Parasitology, Immunology and Mycology so that they can get involved in good patient care and prevention of infectious diseases in the community. They are introduced to basic research methodology so that they can plan and conduct fundamental and applied research. They are also imparted training in teaching methods in the subject which may enable them to take up teaching assignments in medical colleges/ institutes.

2. Program Educational Objectives (PEO):

Programme Educational Objectives are broad statements that describe what graduates are expected to attain within few years of completing their programme. These are based on the needs of the society as analysed and outlined by the regulatory body.

So as defined by Medical Council of India (MCI), the PEO for MD Microbiology are as follows:

- PEO1: Professional who understands and follows the principle of bio-ethics / ethics related to health care system.
- PEO2: Specialist who can provide services in basic as well as advanced laboratory investigations
- PEO3: Communicator possessing adequate communication skills to convey required information in an appropriate manner in various health care setting.
- PEO4: Leader and a team member who understands health care system and act to provide safe patient care with accountability and responsibility.
- PEO5: Lifelong learner keen on updating oneself regarding the advancement in the health care field and able to perform the role of researcher and teacher

3. Program Outcome (PO)

PO's represent broad statements that incorporate many areas of inter-related knowledge and skills developed over the duration of the program through a wide range of courses and experiences. They represent the big picture and describe broad aspects of knowledge, skill and attitude development. They encompass multiple learning experiences.

After a period of 3 years, the resident should be able to attain the following PO's:

After three years of residency program postgraduate should be able to

- PO1: Demonstrate competence as a clinical microbiologist
- PO2 Uphold the prestige of the discipline amongst the fraternity of doctors.
- PO3: Demonstrate application of microbiology in a variety of clinical settings to solve diagnostic and therapeutic problems along with preventive measures.
- PO4: Establish good clinical microbiological services in a hospital and in the community in the fields of bacteriology, virology, parasitology, immunology and mycology.
- PO5: Demonstrate effective communication skills required for the practice of clinical microbiology and while teaching undergraduate students
- PO6: Interact effectively with the allied departments by rendering services in basic as well as advanced laboratory investigations
- PO7: Play a pivotal role in hospital infection control, including formulation of antibiotic policy and management of biomedical waste
- PO8: Acquire skills in conducting collaborative research in the field of Microbiology and allied sciences
- PO9: Conduct such clinical/experimental research as would have significant bearing on human health and patient care
- PO10: Plan, executes, analyze and present the research work in medical microbiology.
- PO11: To acquire various skills for collaborative research
- PO12: Plan, execute and evaluate teaching assignments in Medical Microbiology.
- PO13: To participate is various workshops/seminars/journal clubs/demonstration in the allied departments

4. Course and Course Objectives (CO)

CO's describe the learning that will take place across the curriculum through concise statements, made in specific and measurable terms, of what students will know and /or be able to do after successful completion of each course.

4.1 Course 1 (C1): General Microbiology & Immunology

Objectives: At the end of three years the post graduate student should be able to

- C.1.1 Bio-safety including universal precautions
- C.1.2 Sterilization and disinfection
- C.1.3 Bacterial Pathogenicity
- C.1.4 Molecular genetics relevant for medical microbiology including gene cloning
- C.1.5 Antibacterial substances used in the treatment of infections and drug resistance in bacteria and antibiotic stewardship
- C.1.6 Newer approaches to development of Antimicrobial agents and Antimicrobial Susceptibility testing.
- C.1.7 Bacterial ecology - Normal flora of the human body
- C.1.8 Bacterial ecology -Hospital environment - Air, water and milk
- C.1.9 Quality assurance, quality control and accreditation
- C.1.10 Molecular diagnosis of infectious disease.
- C.1.11 Immune system & Immunity
- C.1.12 Hypersensitivity
- C.1.13 Autoimmunity
- C.1.14 Immunohaematology
- C.1.15 Immunological tolerance
- C.1.16 Transplantation & Tumor immunology
- C.1.17 Prophylaxis and immunotherapy
- C.1.18 Immunopathogenesis and Immunodiagnosis of infectious diseases.
- C.1.19 Immunopotential and Immunomodulation

Skills

- S.1.1 Microscopy for unstained preparations/ wet mount
- S.1.2 Microscopy for stained preparation, Hanging drop
- S.1.3 Performance of various staining techniques
- S.1.4 Operation & maintenance of ELISA reader & washer
- S.1.5 Performance of serological tests

4.2 Course 2 (C2): Systematic Bacteriology

Objectives: At the end of three years the post graduate should be able to

- C.2.1 Isolation and identification of gram positive and gram negative aerobic and anaerobic bacteria.
- C.2.2 Mycobacteria
- C.2.3 Spirochaetes
- C.2.4 Chlamydiae
- C.2.5 Rickettsia, Coxiella, Bartonella&Orientia
- C.2.6 Mycoplasmatales: Mycoplasma, Ureaplasma, Acholeplasma

Skills

- S.2.1 Specimen collection for Blood Culture
- S.2.2 Identification test
- S.2.3 Antimicrobial sensitivity testing- modified Kirby-bauer technique
- S.2.4 IQC- Antibiotic disc potency
- S.2.5 Operation of BacT/ALERT
- S.2.6 Operation of Vitek 2 compact
- S.2.7 Petroff's concentration technique
- S.2.8 AFB culture & sensitivity

4.3 Course 3 (C3): Virology, Mycology & Parasitology

Objectives: At the end of three years the post graduate student should be able to

- C.3.1 Pathogenicity of viruses
- C.3.2 Laboratory diagnosis of viral infections in general.
- C.3.3 Vaccines and antiviral agents
- C.3.4 Pathogenesis and pathology of parasites
- C.3.5 Medical Entomology.
- C.3.6 Common laboratory methods including common culture methods in

Parasitology.

- C.3.7 Immunopathogenesis and Immunodiagnosis of parasitic infections
- C.3.8 General characteristics & classification of fungi
- C.3.9 Isolation & identification of fungi of medical importance:
- C.3.10 In-vitro antifungal susceptibility testing

Skills

- S.3.1 Preparation of clinical specimens for isolation of viruses
- S.3.2 Serological tests-ELISA for HIV, ELISA for HBsAg, HCV, Hepatitis virus, serological tests for arboviruses.
- S.3.3 Collection of various specimens for parasitic infections.
- S.3.4 Examination of faeces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formal-ether methods)
- S.3.5 Examination of blood for protozoa and helminthes by wet mount and thin and thick stained smears - Leishman, Giemsa
- S.3.6 Examination of other specimens e.g. urine, CSF, bone marrow etc. for parasites
- S.3.7 Performance of stains- Leishman, Giemsa
- S.3.8 Identification of common arthropods and other vectors viz., mosquito, sand fly, tick, mite, Cyclops
- S.3.9 QBC/ICT for malaria
- S.3.10 Collection and transport of specimens
- S.3.11 Direct examination of specimens by KOH, Gram's, Kinyoun's, Giemsa, Calcofluor staining and examination under fluorescence microscope.
- S.3.12 Examination of histopathology slides for fungal infections
- S.3.13 Isolation and identification, of fungi of medical importance and identification of contaminants
- S.3.14 Maintenance of stock cultures

4.4 Course 4 (C4): Applied microbiology and Recent advances

Objectives: At the end of three years the post graduate student should be able to

- C.4.1 Epidemiology of infectious diseases
- C.4.2 Hospital acquired infections & Hospital waste management
- C.4.3 Molecular genetics as applicable to Microbiology

- C.4.4 Investigation of an infectious outbreak
- C.4.5 Emerging and re-emerging infections.
- C.4.6 Automation in microbiology.
- C.4.7 Statistical analysis of microbiological data and research methodology.
- C.4.8 Microarray
- C.4.9 Nanotechnology
- C.4.10 Role of Information Technology and Computer in Microbiology.
- C.4.11 National Programme in Infectious disease including IDSP

Skills

- S.4.1 Infection control activities- environmental sampling
- S.4.2 Identification of HAI, Calculation of HAI quality indicators
- S.4.3 Extraction of DNA/RNA, routine PCR protocols, gel electrophoresis and documentation.
- S.4.4 Western blot technique

5. Mapping of PEO, PO and CO

Programme mapping facilitates the alignment of course-level outcomes with programme outcomes. It allows faculty to create a visual map of a programme. It is also used to explore how students are meeting program-level outcomes at the course level. Outcomes mapping focuses on student learning also.

The PEO, PO and the CO are mapped with each other. **(Table 1)**

Table1. Mapping of PEO, PO and CO

	PEO 1		PEO2		PEO3		PEO 4	PEO 5					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
C1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
C2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
C3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
C4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

All courses run concurrently for 3 years with a summative assessment at the end of 3 years. The program is competency based and the competencies, sub-competencies and milestones are detailed. These are mapped to the Entrustable professional activities (EPA) identified as essential for a specialist. Formative assessment is carried out every three months using appropriate tools, for identifying eligibility for transfer of trust.

5.1 Competencies, Sub-competencies and Milestone

The post graduate program is competency based, consisting of six domains of competency. Sub-competencies under these domains, specific to the speciality, have been mentioned in general terms. The progression through the curriculum is detailed in sub-competency milestone levels, that directs the prescribed syllabus. These sub-competency milestones are mapped to the Entrustable Professional Activities (EPAs), identified as essential for a specialist. Formative assessment includes EPA assessment, and is carried out every quarter using appropriate tools, for identifying eligibility for transfer of trust, to the resident.

At the end of the MD course in Microbiology, the student should have acquired various competencies i.e. medical knowledge, patient care, interpersonal communication skill, system based practice, practice based learning and implementation and professionalism . Details of each with milestone as level is described below.(**Table 2**)

Domain of Competencies

1. **Medical Knowledge (MK)** - Demonstrate knowledge of established and evolving biomedical, clinical, epidemiological, and social-behavioural sciences, and the application of this knowledge to patient care.
2. **Patient Care (PC)** - Provide patient-centred care that is compassionate, appropriate, for effective management and acquire skills appropriate for teaching and conducting research.
3. **System Based Practice (SBP)** - Demonstrate the ability to follow the standard operating procedures relevant to practices of the organisations for patient care, inculcating quality and economical practices.
4. **Practice Based Learning and improvement (PBLI)** - Demonstrate the commitment to learn by literature search, feedback, practice and improve upon their ability.
5. **Interpersonal Communication skills (IPCS)** - Demonstrate behaviour and skills that result in the effective communication, exchange of information and cooperation with patients, their families, and health professionals
6. **Professionalism (P)** - Demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles.

Table 2. Description of Competencies, Sub-competencies and Milestone

Medical Knowledge (MK)	Demonstrate knowledge of established and evolving biomedical, clinical, epidemiologic and social-behavioral sciences, as well as the application of this knowledge to patient care.	Level 1	Level 2	Level 3	Level 4	Level 5
MK1	<p>Basic knowledge on pathogenesis of bacterial, viral, parasitic and fungal infections.</p>	<p>Understand the morphology, genetics, antigenic nature, pathogenesis of bacterial, viral, parasitic and fungal infections</p> <p>Understands wide variety of methods employed in the practice of clinical microbiology</p>	<p>Demonstrate knowledge about infections of various organs and systems of human body</p> <p>Demonstrate the classification of the major categories of infections</p> <p>Demonstrate application of knowledge of basic biology and host-pathogen relationship to</p>	<p>Explain the morphology, genetics, antigenic nature, pathogenesis of bacterial, viral, parasitic and fungal infections</p>	<p>Correlate the fundamental (basic) microbiological principles to the pathogenesis, clinical features of the major categories of infections</p>	<p>Educates the morphology, genetics, antigenic nature, pathogenesis, of bacterial, viral, parasitic and fungal infections</p> <p>Apply the fundamental microbiological principles to the pathogenesis, clinical features of the major categories of infections</p>

		including physical and biological containment, universal containment, personal protective equipment for biological agents	Demonstrates knowledge about rapid serological tests for bacterial and viral infection Demonstrates the method to maintain both bacterial & fungal stock culture		interpret serological tests for bacterial and viral infection Perform the method to maintain both bacterial & fungal stock culture	
MK3	Basic knowledge on epidemiology and prevention of bacterial, viral, parasitic and fungal infections.	Understands the knowledge about epidemiology and prevention of infectious diseases	Demonstrate in detail the epidemiology of important human pathogens and their impact on public health	Explain local and global epidemiology of major infectious agents and their disease associations	Suggest the epidemiology of major antimicrobial resistance determinants in important human pathogens and assess the likelihood of such resistance mechanisms being present in a variety of clinical infection scenarios	Educates the epidemiology of important human pathogens and their impact on public health Interpret the epidemiology of major antimicrobial resistance determinants in important human pathogens and assess the likelihood of such resistance mechanisms being present in a variety of clinical infection scenarios
MK4	Newer techniques in laboratory diagnosis	Recalls the effective use information technology	Demonstrate knowledge and applications of Automation in	Apply the knowledge and applications of Automation in Microbiology	Plan the applications about molecular techniques in the laboratory diagnosis	Explain the methods, strengths and limitations of novel techniques such as

Patient Care (PC)	Provide patient-centered care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health)	Level 1	Level 2	Level 3	Level 4	Level 5
PC1	Identification of Hospital acquired infection.	Demonstrate the basic knowledge on common organisms involved in HAI. Explain the chain of infections and definitions of each HAI and its diagnostic criteria according to updated CDC guidelines.	Recognize potential for transmission of infection in all clinical settings. Demonstrate knowledge of evidence based guidelines on hospital acquired infections.	Demonstrate the strategies of Hospital infection prevention and control measures in sequence order.	Maintains effective communication with clinicians and other health care professionals regarding hospital acquired infection, its source identification and preventive measures.	Capable of making critical decision in managing Hospital acquired infection and educating all Healthcare workers in preventive strategies.
PC 2	Biomedical waste management	Demonstrate the knowledge of Biomedical Waste Management according to updated National BMW guidelines.	Identifies effectively all the issues in improper segregation of biomedical waste management in all patient care areas. Counsels on the effectiveness of proper biomedical Waste management.	Demonstrates and Educates the various colour coding bins in BMW segregation. Educates all the steps and procedures involved in Biomedical waste transport, storage	Supervises and educates all the levels of Healthcare workers and especially with those staffs involved in BMW collection and transportation about their needs, responsibilities, personal hygiene, importance of Personal protective equipment's	Applies innovative approaches to recognise all the issues in improper segregation of BMW and its preventive measures. Collaborates and provides consultation to other members of health

PC 3	Support the clinician in managing and re-emerging infections during outbreak.	Demonstrate the knowledge on role of laboratories in outbreaks management. Demonstrate the knowledge on the key principles underpinning outbreak investigation, control, and reporting strategies.	Recognizes the risk factors associated with emerging and re-emerging infections during outbreak. Counsels on the risk factors and preventive methods on emerging infections during outbreak.	Formulates management plans in managing emerging and re-emerging infections during outbreak.	Demonstrate comprehensive understanding of the various patterns of outbreaks investigations and its preventive measures.	Applies innovative approaches for investigating emerging and re-emerging infections during outbreak. Provides comprehensive ideas in investigating outbreaks.	care team members regarding BMW management.
				and final disposal in sequence order. Participates effectively with health care team on biomedical waste management.	and risks of getting HAI. Effectively Educates and supervises HCW's about the importance of Hepatitis B vaccination and Antibody titer estimation. Analyzes the route cause of each Needle sticks injuries and participates in its preventive measures.		

Interpersonal Communication Skills (ICS)	Demonstrate interpersonal and communication skills that result in the effective exchange of information and collaboration with patients, their families, and health professionals	Level 1	Level 2	Level 3	Level 4	Level 5
<p>ICS 1</p> <p>Interact effectively with the allied departments by rendering services in basic as well as advanced laboratory investigations</p>	<p>Understands the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments.</p> <p>Understands the importance of information gathering and sharing, and collaborative teamwork with allied departments.</p>	<p>Demonstrates an understanding of basic as well as advanced Microbiology laboratory investigations to support clinical service and collaborative teamwork with allied departments.</p>	<p>Maintains effective communication with allied departments.</p> <p>Responds to requests for Microbiology laboratory services in a timely manner and provides accurate results of basic as well as advanced Microbiology laboratory investigations with their interpretations.</p> <p>Works effectively in interprofessional and interdisciplinary research and health care teams.</p>	<p>Responds to requests for consultation in a timely manner and communicates recommendations to the requesting personnel.</p> <p>Leads inter-professional and interdisciplinary health care teams to achieve optimal outcomes.</p>	<p>Educates other health care professionals regarding team building.</p> <p>Provides effective consultation in complex and atypical situations.</p> <p>Provide appropriate role modelling.</p> <p>Applies innovative approaches for leading the team.</p>	

<p>ICS2</p>	<p>Communicate to clinicians about selection of antibiotics in case of patients in critical care units.</p>	<p>Understands the principles of antibiotic therapy and antibiotic selection in critical care patients.</p>	<p>Demonstrates an understanding of the roles of clinical microbiologist in antibiotic therapy and infection control in critical care units.</p> <p>Demonstrates an understanding of antibiotic policy, antibiotic stewardship, antimicrobial resistance and infection control.</p>	<p>Maintains effective communication with clinicians and other health care professionals regarding selection of antibiotics in critical care units.</p> <p>Participates in clinical and infection control activities by compiling, analysing and disseminating clinical data on antibiotic usage and infection control.</p> <p>Works effectively with clinicians and health care teams to control hospital acquired infections.</p>	<p>Provides consultation on appropriate antibiotic therapy, choice of antibiotics and infection control.</p> <p>Leads interdisciplinary health care teams to contain and control hospital outbreaks in a timely manner.</p>	<p>Educates clinicians and other health care professionals regarding selection of antibiotics and infection control in critical care units.</p> <p>Applies innovative approaches for facilitating appropriate antibiotic therapy and infection control.</p> <p>Capable of making critical decisions and recommendations for managing the most challenging situations.</p>
<p>ICS3</p>	<p>Communicate to technicians and other non teaching staff for giving instructions to maintain standard protocol in laboratory</p>	<p>Understands the importance of standard protocol for diagnostic tests, safety and quality control in Microbiology laboratory.</p>	<p>Communicates basic knowledge about standard protocol in Microbiology laboratory to technicians and other non- teaching staff.</p> <p>Monitors</p>	<p>Supervise the functioning of the laboratory and adherence to standard protocol.</p> <p>Capable of identifying and managing the non-conformities and deviations from</p>	<p>Educates technicians and other non-teaching staff on protocol for diagnostic tests, safety and quality control in Microbiology laboratory.</p> <p>Leads the department</p>	<p>Provides consultation to other healthcare institutes and laboratories on laboratory accreditation by training of technicians and other non-teaching staff.</p>

	Level 1	Level 2	Level 3	Level 4	Level 5
<p>Demonstrate the ability to follow the standard operating procedures relevant to practices of the organisations for patient care .</p> <p>Aware about Laboratory Quality assurance and quality control.</p>	<p>Understands the basic concept of laboratory quality assurance and the quality control protocol.</p>	<p>Explains the principles of Internal & External Quality assurance and quality control. Works effectively as a team member in formulating the principles of Good Record Keeping, document control, instrument maintenance (quality check) and audit reports making.</p>	<p>Demonstrates commitment to maintain the standards of laboratory practice. Establishes a close rapport with and mutual respect to laboratory staff.</p>	<p>Effectively demonstrate all the types of audits used in quality assurance and quality control. Effectively performs the quality check of all stock cultures and does proficiency testing of technicians according to NABL standards.</p>	<p>Educates other health care professionals regarding quality control and assurance. Applies innovative approaches in various forms of quality checking, documentation and auditing.</p>
<p>Able to implement about quality practices in clinical microbiology laboratory</p>	<p>Understands the Principles of Quality Practices in clinical Microbiology. Observe good laboratory practice</p>	<p>Explain the quality principles in Microbiology laboratory</p>	<p>Demonstrate the ability to follow the SOP and effectively achieve acceptable turnaround time according to the standards.</p>	<p>Recognises the issues in quality practices. Demonstrate willingness to communicate and report regularly with guide and constructively interacts with other clinicians regarding the patient details and management protocol on real time.</p>	<p>Educates other health care team members on quality practices in clinical Microbiology. Organizes Faculty development program on quality Practices in clinical Microbiology laboratory.</p>

Practice-based Learning and PBLI 1	Demonstrate the commitment to learn by practice and improve upon their ability. Lifelong learner keen on updating oneself regarding the advancement in the health care field	Level 1	Shows commitment in being a life-long learner.	Level 2	Updates knowledge on emerging & reemerging infectious diseases pertaining to the geographical area. Updates knowledge on recent advances in diagnosis of infectious diseases	Level 3	Refers and utilizes international & national standards or guidelines on infection prevention and related patient care.	Level 4	Analyse and interpret the outbreaks management. Perform and interpret the advanced microbiological diagnostic techniques.	Level 5	Organizes and leads effectively as a research team member. Analyses and interpret research paper based on recent advancement.
		PBLI 2	Conduct clinical/experiment as a researcher as would have significant bearing on human health and patient care	Understand and apply principles of bioethics and law as they apply to clinical research. Describes commonly used study designs.	Engage in self reflection on utility of research in patient care. Identifies resources pertaining to lacunae in clinical knowledge.	Critically reviews and interprets the literature with the ability to identify study aims, hypotheses, design, and biases	Evaluate research outcomes through the acquisition of data. Evaluate the research hypothesis and interpret the data with appropriate statistical tools.	Interpret the outcomes of clinical / experimental research to improve human health and patient care. Contributes to peer reviewing of clinical research.			

Professionalism (P)	Demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles	Level 1	Level 2	Level 3	Level 4	Level 5
P 1	Demonstrate competence as a clinical microbiologist	Understands the role of a clinical microbiologist in patient care	Develops knowledge on emerging infectious diseases and their prevention strategies	Able to alter the management plan in correlation with the clinical findings, lab investigations appropriately	Critically reviews and interprets antimicrobial sensitivity report. Demonstrate appropriate use and prescription of antibiotic based on toxicity, allergy, hepatic or renal dysfunction in concurrence with evidence based guidelines for both adults and children.	Performs and leads effectively as an infection control practitioner.
P 2	Leader and a team member who understands health care system and act to provide safe patient care with accountability and responsibility	Understands the accountability and responsibility of a microbiologist as a health care team member	Develops knowledge on the epidemiology, presentation, clinical features, investigations (including sample collection), differential diagnosis and	Understand and interpret the microbiological investigation appropriate to the patient clinical condition	Demonstrate communicating effectively on antibiotic policy and stewardship with antimicrobial pharmacist. Explain the rationale use of antimicrobial	Performs effectively as a hospital infection control team member.

P3	Maintain confidentiality in while disclosing certain diagnostic test results .	Understands that microbiologists are accountable to patients, society.	management and prophylaxis of both community acquired and health care associated infections	Shows empathy to the clinical sample and use them cautiously.	Maintains confidentiality while performing tests which have a social stigma	Consistently shows Compassion & integrity while disclosing the results to the patient.	Maintain Confidentiality pertaining to outbreak situation prevailing in the country

6. Syllabus

6.1 Course 1: General Microbiology & Immunology

1. General Microbiology

- History and pioneers in Microbiology
- Microscopy
- Bio-safety including universal precautions
- Morphology of bacteria and other microorganisms
- Nomenclature and classification of microbes
- Growth and nutrition of bacteria
- Bacterial metabolism
- Sterilization and disinfection
- Bacterial virulence factors
- Bacterial antagonism: Bacteriocins
- Bacterial genetics and Bacteriophages
- Molecular genetics relevant for medical microbiology including gene cloning
- Antibacterial substances used in the treatment of infections and drug resistance in bacteria and antibiotic stewardship
- Newer approaches to development of Antimicrobial agents and Antimicrobial Susceptibility testing.
- Bacterial ecology - Normal flora of the human body
 - Hospital environment - Air, water and milk
- Host parasite relationship
- Quality assurance, quality control and accreditation
- Molecular diagnosis of infectious disease.

2. Immunology

- Introduction to immunology
- Immune system - Structure and function
- Immunity
- Immune response - Humoral and cellular
- Antigen

- Immunoglobulin
- Complement
- Antigen and antibody reactions
- Major histocompatibility complex
- Cytokines
- Hypersensitivity
- Immunodeficiency
- Autoimmunity
- Immunohaematology
- Immunological tolerance
- Transplantation immunity
- Tumor immunology
- Prophylaxis and immunotherapy
- Immunopathogenesis and Immunodiagnosis of infectious diseases.
- Immunopotential and Immunomodulation

6.2 Course 2: Systematic Bacteriology

1. Isolation and identification of bacteria.

- Introduction to systematic Bacteriology
 - Isolation and identification of bacteria.

2. Gram positive bacteria

- Gram positive cocci of medical importance including *Staphylococcus*, *Streptococcus*, *Enterococcus*, Anaerobic cocci, etc.
- Gram positive bacilli of medical importance including *Bacillus*, *Clostridium* Coryneform organisms, Actinomyces, Nocardia, Actinobacillus and other *Actinomycetales*, *Erysipelothrix*, *Listeria*, *Lactobacillus* etc

3. Gram negative bacteria

- Gram negative cocci of medical importance including *Neisseria*, *Moraxella*, etc.
- Gram negative bacilli of medical importance including Enterobacteriaceae, *Vibrios*, *Aeromonas*, *Pleisiomonas*, *Haemophilus*,

Bordetella, Brucella, Gardnerella, Pseudomonas, Acinetobacter & other non-fermenters, *Pasturella, Francisella, Yersinia, Bacteroides, Fusobacterium, Leptotrichia*, and other anaerobic Gram negative bacilli, etc.

- Helicobacter, Campylobacter and Spirillum

4. Mycobacteria

5. Spirochaetes

6. Cell wall deficient bacteria

- Chlamydiae
- Rickettsia, Coxiella, Bartonella & Orientia
- Mycoplasmatales: *Mycoplasma, Ureaplasma, Acholeplasma*

7. Miscellaneous bacteria –

- Legionella, HACEK, and all other medically important bacteria

6.3 Course 3 (C3): Virology, Mycology & Parasitology

1. Virology

- General properties of viruses.
- Classification of viruses
- Morphology: virus structure
- Virus replication
- Viral interference
- The genetics of viruses
- The pathogenicity of viruses
- Laboratory diagnosis of viral infections in general .
- Vaccines and antiviral agents
- DNA viruses of medical importance including Poxviridae, Herpesviridae,
- Adenoviridae, Hepadnavirus, Papova and Parvoviruses
- RNA viruses of medical importance including Enteroviruses, Togaviridae, Flaviviridae, Myxoviridae, Reoviridae, Rhabdoviridae, Arenaviridae, Bunyaviridae, Retroviridae, Filoviruses, Human immunodeficiency virus, Arboviruses, Cononaviridae, Calciviruses
- Oncogenic viruses and Teratogenic viruses
- Miscellaneous–Rubella, Slow viruses. prions, Viral hemorrhagic fever viruses, Virus causing gastro enteritis and other emerging newer viruses.

2. Parasitology

- Introduction to Parasitology
 - General characteristics and classification of parasites
 - Pathogenesis and pathology of parasite
- Protozoan parasites of medical importance including *Entamoeba*, *Giardia*, *Balantidium coli*, *Trichomonas*, intestinal coccidian parasites of medical importance, *Toxoplasma Sarcocystis*, blood parasites including *Plasmodium*, *Leishmania*, *Trypanosomes*.
- Cestodes of medical importance including, *Diphyllobothrium latum*, *Spirometra*,
Taenia, *Echinococcus*, *Hymenolepis*, *Dipylidium caninum*.
- Trematodes of medical importance *Schistosoma*, *Fasciola*, *Fasciolopsis buski*, *Paragonimus*, *Clonorchis*, other trematodes.
- Nematodes of medical importance such as *Trichuris*, *Trichinella*, *Capillaria*, *Strongyloides*, *Ancylostoma*, *Necator*, *Enterobius*, *Ascaris*, *Toxocara*, Agents causing larva migrans, tissue nematodes including, Filarial worms, *Dracunculus medinensis*.
- Medical Entomology.
- Common laboratory methods including common culture methods in Parasitology.
- Anti parasitic agents.
- Immunopathogenesis and Immunodiagnosis of parasitic infections.

3. Mycology

- Introduction to Mycology
- General characteristics & classification of fungi
- Morphology & reproduction of fungi
- Isolation & identification of fungi
- Fungi of medical importance:
- Yeasts, Yeast like, Moulds, Dimorphic fungi etc

- Mycotoxins
- Antifungal agents and *in-vitro* antifungal susceptibility testing

6.4 Course 4 (C4): Applied microbiology and Recent advances

1. Applied Microbiology

- Investigation of an infectious outbreak including infections of various organs and systems of human body viz. sexually transmitted diseases, respiratory tract infections, urinary tract infections, central nervous system infections, congenital infections, reproductive tract infections, gastrointestinal infections, hepatitis, Fever of unknown origin (FUO), infections of eye, ear & nose, septicaemia, endocarditis, hemorrhagic fever, etc.
- Emerging and re-emerging infections
- National Programme in Infectious disease including IDSP
- Demonstration of pathogen in tissue section
- Vaccinology: principle, methods of preparation, administration of vaccines
- Care & handling of animals and ethics
- Opportunistic infections
- Bioterrorism
- Zoonotic disease
- Epidemiology of infectious diseases

2. Hospital acquired infections

- Hospital acquired infections
- Hospital waste management

3. Recent advances in diagnostic Microbiology

- Molecular genetics as applicable to Microbiology
- Automation in microbiology
- Microarray
- Nanotechnology

4. Research Methodology

- Statistical analysis of microbiological data and research methodology.
- Role of Information Technology and Computer in Microbiology.

7. Teaching/Learning Methods

- Learning in M.D Microbiology will essentially be self-learning under the guidance of teachers.
- Following teaching-learning methods shall be followed

Group teaching sessions:

- Culture seminar (Bacteriology and Mycology)
- Topic seminar presentation
- Journal review
- Group discussion
- Slides seminars
- Technique seminar
- Presentation of the findings of an exercise on any of the sub-specialties
- Participation in CME programs, workshops and conferences.
- Faculty teaching sessions
- Ward rounds

Hands on Experience (Practical Training)

Practical training shall be imparted by posting the students in various sub-specialties (sections) as detailed in the list below. Student shall be actively involved in day to day working of all the sections. He/she will be trained under the guidance of teachers in all the aspects of Microbiology- collection and transport of specimens, receiving of samples, preparation of requisite reagents, chemicals, media, antibiotic discs, processing of specimens and reporting on the specimens, sterilization procedures, bio-safety precautions, and maintenance of equipments, maintenance of laboratory animals, record keeping and quality control in Microbiology.

Suggested Schedule of Postings

A. Internal postings: - I year

1. Observation	1 month
2. Media preparation and Sterilization procedures	2 months
3. Diagnostic sections observation	1 month
4. Bacteriology (Aerobic and anaerobic)	4 months
5. Mycobacteriology	2 month
6. Serology/Immunology	1 month

II year

7. Bacteriology (Aerobic and anaerobic)	2 months
8. Serology/Immunology	1 month
9. Mycology	1 month
10. Virology(serology)	1 month
11. Parasitology	1 month
12. Central laboratory postings (Central lab)	2 months
13. External postings	3 months
14. Inter departmental postings	1 month

(Pathology, Biochemistry, DVL & CSSD, Community Medicine, Respiratory Medicine)

III year

15. Bacteriology (Aerobic and anaerobic)	4 months
16. Serology/Immunology	1 month
17. Mycology	1 month
18. Virology (serology)	1 month
19. Parasitology	1 months
20. Hospital infection surveillance	2 month
21. Dissertation submission	1 month

Total	34 months
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Skills for Postgraduate students in MD Microbiology

Bacteriology - Must Acquire

1. Care and operation and Knowledge of maintenance of commonly used instruments
2. Preparation and pouring of routinely used and common Medias in Microbiology lab
3. Operation of autoclave, hot air oven, distillation plant, membrane filter and sterility tests
4. Washing and sterilization of glass wares
5. Preparation of commonly used reagents, chemicals & stains.
6. Testing of disinfectants-phenol coefficient and "in use" tests
7. Quality control of media, reagents, equipments etc
8. Collection of specimens for microbiological investigations (blood, urine, throat swab, rectal swab, stool, pus (swabs) etc.) from the hospital environment.
9. Aseptic practices in laboratory and safety precautions
10. Preparation of antibiotic discs: performance of antibiotic sensitivity tests by Kirby Bauer, Stokes method, E test etc. Estimation of minimal inhibitory/bactericidal concentration by broth/ agar dilution method
11. Tests for detection of resistance mechanisms in bacteria both phenotypic and genotypic.
12. Isolation and Identification of bacteria of medical importance up to species level (except anaerobes which could be up to genus level)
13. Techniques of anaerobiosis.
14. Preparation, examination and interpretation of direct smears from clinical specimens viz. sputum for AFB-ZN, auramine O, slit smears for *M.leprae* for ZN staining, conjunctival smears for Chlamydia by Giemsa/Iodine
15. Bacteriological tests for air, water, milk and food.
16. Maintenance and preservation of bacterial cultures.
17. Automated BACTEC system & automated anaerobic system Bacteriology -

Desirable to acquire

1. Antibiotic susceptibility tests for Mycobacteria
2. Molecular typing methods.
3. Special staining techniques for Mycoplasma, Treponemes, Gardnerella, Leptospira
4. Care and breeding of laboratory animals viz. mice, rats, guinea pigs and rabbits
5. Bleeding techniques from animals including sheep for the preparation of culture media

Immunology - Must acquire

1. Collection of blood by venepuncture, separation of serum and preservation of serum for short and long periods
2. Preparation of bacterial antigens for Widal test.
3. Performance of serological tests viz. Widal, Brucella tube agglutination, VDRL, ASO, TPHA etc.
4. Enzyme linked immunosorbent assay
5. IFA

Immunology - desirable to acquire

1. Immunoelectrophoresis
2. Immunodiffusion in gels, (Ouchterlony) counter immunoelectrophoresis
3. Haemagglutination(HA) and Haemagglutination inhibition(HAI) test
4. Immunoblotting.
5. Performance of serological tests viz-Weil-Felix, Cold agglutination.

Mycology - Must acquire

1. Collection and transport of specimens
2. Direct examination of specimens by KOH, Gram's, Kinyoun's, Giemsa, Calcofluor staining and examination under fluorescence microscope.
3. Examination of histopathology slides for fungal infections
4. Isolation and identification, of fungi of medical importance and identification of contaminants
5. Maintenance of stock cultures

Mycology - Desirable to acquire

1. Antigen and antibody based serological test in fungal diseases including *Candida*, *Cryptococcosis*, *Aspergillus*, etc.
2. Speciation of candida species
3. Special techniques Special techniques like Wood's lamp examination, hair baiting / hair perforation, paraffin baiting and slide culture

Parasitology - Must Acquire

1. Collection of various specimens for parasitic infections.
2. Examination of faeces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formal-ether methods)
3. Examination of blood for protozoa and helminthes by wet mount and thin and thick stained smears - Leishman, Giemsa
4. Examination of other specimens e.g. urine, CSF, bone marrow etc. for parasites
5. Performance of stains- Leishman, Giemsa
6. Identification of common arthropods and other vectors viz., mosquito, sand fly, tick, mite, Cyclops
7. QBC/ICT for malaria

Parasitology - Desirable to Acquire

1. Permanent staining techniques like iron haematoxylin
2. In-vitro culture of parasites like *Entamoeba*, *Leishmania*, etc.
3. Preparation of media- NNN etc
4. Egg counting techniques for helminthes
5. Histopathology sections-examination and identification of parasites
6. Copro-culture of larva of hookworms
7. Preservation of parasites- mounting, fixing, staining, etc

Virology - Must acquire

1. Preparation of glass wares for tissue cultures (washing, sterilization)
2. Preparation of media like Hanks, MEM
3. Preparation of clinical specimens for isolation of viruses
4. Serological tests-ELISA for HIV, ELISA for HBsAg, HCV, Hepatitis virus, serological tests for arboviruses.

Virology-Desirable to acquire

1. Performance of haemadsorption for Parainfluenza, Haemagglutination for Influenza, Immunofluorescence, neutralization for Enteroviruses and

Respiratory viruses, identification tests on tissue cultures and supernatants, etc.

2. Electron microscopy of virus -TEM, SEM
3. Recognition of CPE in tissue cultures.
4. Maintenance of continuous cell lines by subcultures. Preservation in -70°C and liquid nitrogen
5. Chick embryo techniques-inoculation and harvesting
6. Handling of mice, rat, rabbit and guinea pigs for collection of blood, etc.

Molecular biology - Must acquire

1. Extraction of DNA/RNA, routine PCR protocols, gel electrophoresis and documentation.
2. Western blot technique.

Molecular biology- Desirable to acquire

1. RFLP, RAPD
2. SDS PAGE

Time frame for skill acquisition (as per MCI Competencies)

1 st year residency-skills list					
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 & Quality Control (QC) of culture media	20	20	30
	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	--
Performance of serological tests	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	IQC-serology	5	5	5

2 nd year residency-skill list					
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 bloodsmear	-	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
Performance of serological tests	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	IQC-serology	--	--	5

3 rd year residency-skill list					
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	--	--	2

		for <i>C. parvum</i>			
Serology/ Immunology	1	Phlebotomy & separation of serum	--	--	5
	2	Operation & maintenance of mini-VIDAS	--	--	20
	3	Operation & maintenance of ELISA reader & washer	--	--	20
Performance of serological tests	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	IQC-serology	--	--	5

8. Assessment

8.1 Formative Assessment

i.e., assessment during the training

It will be continual and would assess medical knowledge, patient care, procedural and academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system.

Quarterly assessment will be conducted as per categories listed in post graduate student appraisal form available from MCI guidelines (Annexure I)

Table 3: List the of Entrustable Professional Activity

S.No	Entrustable Professional Activity
1.	Should be able to carry out various methods of sterilization process
2.	Should be able to perform & interpret various staining techniques like gram staining. acid fast staining. negative staining and special staining
3.	Should be able to perform & interpret motility of bacteria by hanging drop preparation of clinical specimen.
4.	Should be able to maintain both bacterial & fungal stock culture.
5.	Should be able to carry out antibiotic sensitivity testing as per standard guidelines.
6.	Should be able to interpret & report to clinician about peripheral blood smear for parasites.
7.	Should be able to identify the pathogenic bacteria by aerobic and anaerobic culture methods.
8.	Should be able to perform & confirm the identification of fungus by routine fungal culture of clinical specimen.
9.	Should be able to perform and interpret rapid serological tests for bacterial and viral infection
10.	Should be able to perform various other serology techniques like ELISA, IFA.
11.	Should be able to perform diagnostic tests using automated machines.

12.	Should be able to perform Molecular techniques for diagnosing various infectious diseases.
13.	Should be able to manage needle stick injury.
14.	Should be able to instruct the technician for handling & disposal of biomedical wastes.
15.	Should be aware & able to implement Infection control practices
16.	Should be familiar with norms & requirements of NABL, NABH accreditation
17.	Should be able to prepare protocol for investigating any outbreak in the area like cholera, typhoid, brucellosis and viral infections.
18.	Should be able to carry out systematic research work
19.	Should be able to perform as a team worker / leader.
20.	Should be able to teach Microbiology for undergraduate medical students.

Table 4: EPAs, Competency levels and entrustability

Description of Entrustable Professional Activity with relevant domains of competence, domain critical behaviour

EPA 1:Should be able to carry out various methods of sterilization process	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects of Sterilisation and disinfection methods practised in hospitals. Able to perform sterilisation techniques using autoclaves, hot air oven, inspissator
2. Most relevant domains of competence:	MK , PC,ICS, P
3. Competencies within each domain critical to entrustment decisions	MK5.1, MK 5.5;PC 2.1; ICS 3.1, ICS 3.2, ICS 3.4, ICS 4.2, ICS 4.3;P 1.4
4.Methods of assessment	1. Written Examination 2.Work place assessment

Competency	Pre-Entrustable	Entrustable
MK5	<p>Fails to demonstrate in depth knowledge about various method of Sterilization and disinfection practices in laboratory as well as in hospital settings</p> <p>Fail to demonstrate knowledge about management of biomedical waste</p> <p>Unable to explain about the management of biomedical waste</p> <p>Unable to instruct the technician for handling & disposal of biomedical wastes.</p>	<p>Demonstrates in depth knowledge about various method of Sterilization and disinfection practices in laboratory as well as in hospital settings</p> <p>Demonstrate knowledge about management of biomedical waste</p> <p>Explains about the management of biomedical waste</p> <p>Instruct the technician for handling & disposal of biomedical wastes.</p>
PC2	<p>Fail to demonstrate the knowledge of Biomedical Waste Management according to updated National BMW guidelines</p>	<p>Demonstrate the knowledge of Biomedical Waste Management according to updated National BMW guidelines</p>
ICS3	<p>Fail to understand the importance of standard protocol for handling various sterilization equipment in a Microbiology laboratory.</p> <p>Fail to communicate basic knowledge about standard protocol for handling various sterilization equipment to technicians and other non-teaching staff.</p> <p>Fail to educate technicians and other non-teaching staff on protocol for handling various sterilization equipment in Microbiology laboratory.</p>	<p>Understands the importance of standard protocol for handling various sterilization equipment in a Microbiology laboratory.</p> <p>Communicates basic knowledge about standard protocol for handling various sterilization equipment to technicians and other non-teaching staff.</p> <p>Educates technicians and other non-teaching staff on protocol for diagnostic tests, safety and quality control in Microbiology laboratory.</p>
ICS4	<p>Fail to explain classification, principle and application of various sterilization process effectively in lucid manner engaging both slow-learners and advanced-learners</p> <p>Unable to interact with students to encourage discussion on various methods of sterilization process and to assess their level of understanding.</p>	<p>Explains classification, principle and application of various sterilization process effectively in lucid manner engaging both slow-learners and advanced-learners</p> <p>Interacts with students to encourage discussion various methods of sterilization process and to assess their level of understanding.</p>
P1	<p>Fail to demonstrate appropriate use of sterilization methods.</p>	<p>Demonstrates appropriate use of sterilization methods.</p>

EPA 2: Should be able to perform & interpret various staining techniques like gram staining, acid fast staining. negative staining and special staining	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects of staining techniques (Classification, principle, procedure and their application) Able to perform the all kinds of staining techniques in Microbiology Able to interpret the stained smear/mount from clinical specimens
2. Most relevant domains of competence:	MK ,ICS ,P
3. Competencies within each domain critical to entrustment decisions	MK 2.1, MK 2.3, MK 2.4; ICS 1.3, ICS 1.4, ICS 4.2, ICS 4.3;P 1.4
4.Methods of assessment	1. Written Examination 2. Practical Examination 3.Work place assessment

Competency	Pre-Entrustable	Entrustable
MK 2	Fail to understand the basic as well as advanced knowledge in various staining techniques used in diagnostic microbiology. Unable to perform basic laboratory techniques, including Gram-staining, acid fast staining. negative staining and special staining on clinical samples. Fail to provide examination and interpretation of direct smears and wet mount from clinical specimens requesting personnel	Understands the basic as well as advanced knowledge in various staining techniques used in diagnostic microbiology. Performs basic laboratory techniques, including Gram-staining, acid fast staining. negative staining and special staining on clinical samples. Provides examination and interpretation of direct smears and wet mount from clinical specimens personnel
ICS 1	Fail to respond to requests for Microbiology laboratory services including Gram-staining, acid fast staining, negative staining and special staining in a timely manner and provide accurate results with their interpretations.	Responds to requests for Microbiology laboratory services including Gram- staining, acid fast staining, negative staining and special staining in a timely manner and provides accurate results with their interpretations.

	Fail to respond to requests for consultation in a timely manner and communicate recommendations to the	Responds to requests for consultation in a timely manner and communicates recommendations to the requesting
ICS 4	Fail to explain the staining techniques effectively in lucid manner engaging both slow-learners and advanced-learners. Fail to interact with students to encourage discussion and to assess their level of understanding	Explains the staining techniques effectively in lucid manner engaging both slow-learners and advanced-learners. Interacts with students to encourage discussion and to assess their level of understanding
P1	Fail to demonstrate appropriate use of various staining techniques	Demonstrates appropriate use of various staining techniques

EPA 3: Should be able to perform & interpret motility of bacteria by hanging drop preparation of clinical specimen	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects of bacterial motility <ul style="list-style-type: none"> • Ultrastructure, arrangement, types of flagella • Methods of detection of flagella • Types of motility • Different methods of demonstrating bacterial motility Able to perform the hanging drop technique Able to interpret the hanging drop preparation from clinical specimen especially cholera stool. Able to differentiate between true motility and false motility
2. Most relevant domains of competence:	MK , PC,ICS, P
3. Competencies within each domain critical to entrustment decisions	MK 2.1, MK 2.3, MK 2.4; PC 3.1 ;ICS 1.3, ICS 1.4, ICS 4.2, ICS 4.3; P 1.4
4.Methods of assessment	1. Written Examination 2. Practical Examination 3.Work place assessment

Competency	Pre-Entrustable	Entrustable
MK2	<p>Fail to understand the basic knowledge in direct microscopy techniques used in diagnostic microbiology.</p> <p>Unable to perform hanging drop preparation on clinical samples.</p> <p>Fail to provide examination and interpretation of wet mount from clinical specimens</p>	<p>Understands the basic knowledge in direct microscopy techniques used in diagnostic microbiology.</p> <p>Performs basic hanging drop preparation on clinical samples.</p> <p>Provides examination and interpretation of wet mount from clinical specimens</p>
PC3	<p>Fail to demonstrate the knowledge on role of laboratories investigating a Cholera outbreak</p>	<p>Demonstrate the knowledge on role of laboratories investigating a Cholera outbreak.</p>
ICS 1	<p>Fail to respond to requests for Microbiology laboratory services including hanging drop preparation on stool sample from suspected cholera case in a timely manner and provide accurate results with their interpretations.</p> <p>Fail to respond to requests for consultation in a timely manner and communicates recommendations to the requesting personnel</p>	<p>Responds to requests for Microbiology laboratory services including hanging drop preparation on stool sample from suspected cholera case in a timely manner and provides accurate results with their interpretations.</p> <p>Responds to requests for consultation in a timely manner and communicates recommendations to the requesting personnel</p>
ICS 4	<p>Fail to explain the hanging drop preparation and its application, effectively in lucid manner engaging both slow- learners and advanced-learners.</p> <p>Fail to interact with students to encourage discussion and to assess their level of understanding</p>	<p>Explains the hanging drop preparation and its application, effectively in lucid manner engaging both slow-learners and advanced-learners.</p> <p>Interacts with students to encourage discussion and to assess their level of understanding</p>
P1	<p>Fail to demonstrate appropriate use of various staining techniques</p>	<p>Demonstrates appropriate use of various staining techniques</p>

EPA 4: Should be able to maintain both bacterial & fungal stock culture	
1. Description of the activity:	Able to explain theoretical aspects of maintenance of both bacterial & fungal stock culture which comprises of different types of methods, media, storage conditions, frequency of transfer, quality control procedure, recovery/reconstitution. Able to perform both bacterial & fungal stock culture
2. Most relevant domains of competence:	MK, ICS
3. Competencies within each domain critical to entrustment decisions	MK 1.1, MK 1.3, MK 2.2, MK 2.3, MK 2.4; ICS 3.2, ICS 3.4
4. Methods of assessment	1. Written Examination 2. Work place assessment

Competency	Pre-Entrustable	Entrustable
MK 1	Fail to understand the morphology and pathogenesis of bacterial and fungal infections Unable to explain the morphology, genetics, antigenic nature, pathogenesis of bacterial , viral , parasitic and fungal infections	Understands the morphology and pathogenesis of bacterial and fungal infections Explains the morphology, genetics, antigenic nature, pathogenesis of bacterial , viral , parasitic and fungal infections
MK 2	Fail to demonstrate knowledge about isolation and identification of medically important microorganism Unable to isolate and identify of medically important microorganism Fail to demonstrate the method to maintain both bacterial & fungal stock culture. Unable to perform the method to maintain both bacterial & fungal stock culture	Demonstrates knowledge about isolation and identification of medically important microorganism Able to isolate and identify of medically important microorganism Demonstrates the method to maintain both bacterial & fungal stock culture. Perform the method to maintain both bacterial & fungal stock culture

ICS 3	<p>Unable to communicate basic knowledge about standard protocol of bacterial and fungal stock maintenance in Microbiology laboratory to technicians.</p> <p>Fail to educate technicians on protocol for bacterial and fungal stock maintenance in Microbiology laboratory</p>	<p>Communicates basic knowledge about standard protocol of bacterial and fungal stock maintenance in Microbiology laboratory to technicians.</p> <p>Educates technicians on protocol for bacterial and fungal stock maintenance in Microbiology laboratory</p>
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EPA 5: Should be able to carry out antibiotic sensitivity testing as per standard guidelines	
1. Description of the activity:	<p>Able to explain theoretical aspects of antibiotic sensitivity testing (types, media used, antibiotic disk, procedure, MIC,MBC, antibiotic resistance and its detection)</p> <p>Able to perform antibiotic sensitivity testing in the laboratory.</p> <p>Able to choose the relevant antibiotics based on the isolate and clinical scenario which is most important in choosing the antibiotics for therapeutic purposes.</p> <p>Able to interpret the results</p>
2. Most relevant domains of competence:	MK , ICS, P
3. Competencies within each domain critical to entrustment decisions	MK 2.1, MK 2.3, MK 2.5, MK 5.3, MK 5.4; ICS 2.1, ICS 2.2, ICS 2.3, ICS 2.4, ICS 2.5; ICS 3.2, ICS 3.4; ICS 4.2, ICS 4.3; P1.4
4.Methods of assessment	<ol style="list-style-type: none"> 1. Written Examination 2. Practical Examination 3. Work place assessment

Competency	Pre-Entrustable	Entrustable
MK2	<p>Fail to Understand the newer approaches to development of Antimicrobial agents and Antimicrobial Susceptibility testing</p> <p>Unable to Perform basic laboratory techniques, including antimicrobial susceptibility testing.</p> <p>Fail to Educate to Select appropriate anti- infective therapies for a wide range of important infections</p>	<p>Understands the newer approaches to development of Antimicrobial agents and Antimicrobial Susceptibility testing</p> <p>Performs basic laboratory techniques, including antimicrobial susceptibility testing.</p> <p>Educates to Select appropriate anti- infective therapies for a wide range of important infections</p>

<p>MK5</p>	<p>Fail to apply the knowledge about antimicrobial prophylaxis and therapy Unable to correlates and Interprets how therapeutic or prophylactic antimicrobial interventions are used in clinical management – and of how the outcome of such patients may be investigated, predicted and monitored for iatrogenic adverse effects</p>	<p>Applies the knowledge about antimicrobial prophylaxis and therapy Correlates and Interprets how therapeutic or prophylactic antimicrobial interventions are used in clinical management – and of how the outcome of such patients may be investigated, predicted and monitored for iatrogenic adverse effects</p>
<p>ICS2</p>	<p>Fail to understand the principles of antibiotic therapy and antibiotic selection in critical care patients. Fail to demonstrate an understanding of the roles of clinical microbiologist in antibiotic therapy and infection control in critical care units. Fail to demonstrate an understanding of antibiotic policy, antibiotic stewardship, antimicrobial resistance and infection control. Unable to maintain effective communication with clinicians and other health care professionals regarding selection of antibiotics in critical care units. Fail to participate in clinical and infection control activities by compiling, analysing and disseminating clinical data on antibiotic usage and infection control. Fail to provide consultation on appropriate antibiotic therapy, choice of antibiotics and infection control Fail to educate clinicians and other health care professionals regarding selection of antibiotics and infection control in critical care units. Unable to apply innovative approaches for facilitating appropriate antibiotic therapy and infection control.</p>	<p>Understands the principles of antibiotic therapy and antibiotic selection in critical care patients. Demonstrates an understanding of the roles of clinical microbiologist in antibiotic therapy and infection control in critical care units. Demonstrates an understanding of antibiotic policy, antibiotic stewardship, antimicrobial resistance and infection control. Maintains effective communication with clinicians and other health care professionals regarding selection of antibiotics in critical care units. Participates in clinical and infection control activities by compiling, analysing and disseminating clinical data on antibiotic usage and infection control. Provides consultation on appropriate antibiotic therapy, choice of antibiotics and infection control Educates clinicians and other health care professionals regarding selection of antibiotics and infection control in critical care units. Applies innovative approaches for facilitating appropriate antibiotic therapy and infection control.</p>

ICS3	<p>Unable to communicate basic knowledge about standard protocol of antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory to technicians.</p> <p>Fail to educate technicians and other non- teaching staff on protocol for antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory</p>	<p>Communicates basic knowledge about standard protocol of antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory to technicians.</p> <p>Educates technicians and other non-teaching staff on protocol for antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory</p>
ICS4	<p>Fail to explain the antibiotic sensitivity testing and its application, effectively in lucid manner engaging both slow-learners and advanced-learners.</p> <p>Fail to interact with students to encourage discussion and to assess their level of understanding</p>	<p>Explains the antibiotic sensitivity testing and its application, effectively in lucid manner engaging both slow- learners and advanced-learners.</p> <p>Interacts with students to encourage discussion and to assess their level of understanding</p>
P1	<p>Fail to critically review and interprets antimicrobial sensitivity report.</p> <p>Fail to demonstrate appropriate use and prescription of antibiotic based on toxicity, allergy, hepatic or renal dysfunction in concurrence with evidence based guidelines for both adults and children</p>	<p>Critically reviews and interprets antimicrobial sensitivity report.</p> <p>Demonstrate appropriate use and prescription of antibiotic based on toxicity, allergy, hepatic or renal dysfunction in concurrence with evidence based guidelines for both adults and children</p>

Description of Entrustable Professional Activity with relevant domains of competence, domain critical behaviour

EPA 6: Should be able to interpret & report to clinician about peripheral blood smear for parasites	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects of pathogenesis, life cycle and laboratory diagnosis of haemoparasites Able to perform and interpret peripheral blood smear examination
2. Most relevant domains of competence:	MK , ICS, P
3. Competencies within each domain critical to entrustment decisions	MK 2.1, MK 2.3, MK 2.4; ICS 1.3, ICS 1.4;P 1.4
4.Methods of assessment	1. Written Examination 2.Work place assessment 3. Practical Examination

Competency	Pre-Entrustable	Entrustable
MK 2	Fail to understand the basic as well as advanced knowledge in peripheral blood smear examination in diagnostic microbiology. Unable to perform peripheral blood smear examination Fail to provide examination and interpretation of peripheral blood smear examination	Understands the basic as well as advanced knowledge in peripheral blood smear examination in diagnostic microbiology. Performs peripheral blood smear examination Provides examination and interpretation of peripheral blood smear examination
ICS 1	Fail to respond to requests for Microbiology laboratory services like peripheral blood smear examination in a timely manner and provide accurate results with their interpretations. Fail to respond to requests for consultation in a timely manner and communicate recommendations to the requesting personnel	Responds to requests for Microbiology laboratory services like peripheral blood smear examination in a timely manner and provide accurate results with their interpretations Responds to requests for consultation in a timely manner and communicates recommendations to the requesting personnel

ICS 4	Fail to explain the peripheral blood smear examination effectively in lucid manner engaging both slow-learners and advanced-learners. Fail to interact with students to encourage discussion and to assess their level of understanding	Explains peripheral blood smear examination effectively in lucid manner engaging both slow-learners and advanced-learners. Interacts with students to encourage discussion and to assess their level of understanding
P1	Fails to interpret and report peripheral blood smear examination	Interpret and report peripheral blood smear examination

EPA 7: Should be able to identify the pathogenic bacteria by aerobic and anaerobic culture methods.	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects various methods of cultivation of bacteria (aerobic and anaerobic methods, medias required, inoculation of sample, temperature, oxygen requirement,) Able to perform aerobic and anaerobic culture methods
2. Most relevant domains of competence:	MK , ICS
3. Competencies within each domain critical to entrustment decisions	MK1.1, MK 2.2 ;ICS1.3, ICS 1.4, ICS 1.1, ICS 2.1, ICS 2.2, ICS 2.3, ICS 2.4, ICS 2.5, ICS 3.2, ICS 3.4, ICS 4.2, ICS 4.3
4.Methods of assessment	1.Written Examination 2.Work place assessment 3. Practical Examination 4. Culture seminar

Competency	Pre-Entrustable	Entrustable
MK1	Fail to understand the morphology, genetics, antigenic nature and pathogenesis of aerobic and anaerobic bacterial infections Fail to understand wide variety of aerobic and anaerobic culture methods	Understands the morphology, genetics, antigenic nature and pathogenesis of aerobic and anaerobic bacterial infections Understands wide variety of aerobic and anaerobic culture methods
MK2	Fail to demonstrate knowledge about isolation and identification of medically important aerobic and anaerobic bacteria	Demonstrates knowledge about isolation and identification of medically important aerobic and anaerobic bacteria

	<p>Fail to demonstrate Collection/transportation of specimens for aerobic and anaerobic culture</p> <p>Demonstrate plating of clinical specimens on aerobic and anaerobic media for isolation, purification, identification and quantification purposes.</p>	<p>Demonstrate Collection/transportation of specimens for aerobic and anaerobic culture</p> <p>Demonstrate plating of clinical specimens on aerobic and anaerobic media for isolation, purification, identification and quantification purposes.</p>
ICS 1	<p>Fail to respond to requests for Microbiology laboratory services including aerobic and anaerobic bacterial culture in a timely manner and provide accurate results with their interpretations.</p> <p>Fail to respond to requests for consultation in a timely manner and communicates recommendations to the requesting personnel</p> <p>Fail to understand the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments</p> <p>Fail to Maintains effective communication with allied departments.</p> <p>Unable to responds to requests for Microbiology laboratory services in a timely manner and provides accurate results</p>	<p>Responds to requests for Microbiology laboratory services including services including aerobic and anaerobic bacterial culture in a timely manner and provides accurate results with their interpretations.</p> <p>Responds to requests for consultation in a timely manner and communicates recommendations to the requesting person</p> <p>Understand the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments</p> <p>Maintains effective communication with allied departments.</p> <p>Responds to requests for Microbiology laboratory services in a timely manner and provides accurate results</p>
ICS 2	<p>Fails to understand the principles of antibiotic therapy and antibiotic selection in critical care patients.</p> <p>Fails to demonstrate an understanding of the roles of clinical microbiologist in antibiotic therapy and infection control in critical appropriate antibiotic therapy and infection control.</p>	<p>Understands the principles of antibiotic therapy and antibiotic selection in critical care patients.</p> <p>Demonstrates an understanding of the roles of clinical microbiologist in antibiotic therapy and infection control in critical care units.</p> <p>Demonstrates an understanding of antibiotic policy, antibiotic stewardship, antimicrobial resistance and infection control.</p>

		<p>Maintains effective communication with clinicians and other health care professionals regarding selection of antibiotics in critical care units.</p> <p>Participates in clinical and infection control activities by compiling, analysing and disseminating clinical data on antibiotic usage and infection control.</p> <p>Provides consultation on appropriate antibiotic therapy, choice of antibiotics and infection control</p> <p>Educates clinicians and other health care professionals regarding selection of antibiotics and infection control in critical care units.</p> <p>Applies innovative approaches for facilitating appropriate antibiotic therapy and infection control.</p>
ICS3	<p>Unable to communicate basic knowledge about standard protocol of antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory to technicians and other non- teaching staff.</p> <p>Fail to educate technicians and other non-teaching staff on protocol for antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory</p>	<p>Communicates basic knowledge about standard protocol of antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory to technicians and other non-teaching staff.</p> <p>Educates technicians and other non-teaching staff on protocol for antibiotic sensitivity testing as per standard guidelines in Microbiology laboratory</p>
ICS 4	<p>Fail to explain the aerobic and anaerobic culture methods effectively in lucid manner engaging both slow-learners and advanced- learners.</p> <p>Fail to interact with students to encourage discussion and to assess their level of understanding</p>	<p>Explains aerobic and anaerobic culture methods effectively in lucid manner engaging both slow-learners and advanced-learners.</p> <p>Interacts with students to encourage discussion and to assess their level of understanding</p>

EPA 8: Should be able to perform & confirm the identification of fungus by routine fungal culture of clinical specimen.	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects of classification, pathogenesis and laboratory diagnosis of various fungal infections Able to perform and confirm the identification of fungus by routine fungal culture of clinical specimen.
2. Most relevant domains of competence:	MK , ICS
3. Competencies within each domain critical to entrustment decisions	MK 1.1, MK 1.5, MK 2.2, MK 2.3: ICS1.1 ICS,1.3, ICS 1.4, ICS 3.2, ICS 3.3, ICS 4.2, ICS 2.3
4.Methods of assessment	1. Written Examination 2.Work place assessment 3. Practical Examination 4. Cuture seminar

Competency	Pre-Entrustable	Entrustable
MK1	Fail to understand the morphology, genetics, antigenic nature and pathogenesis of fungal infections Fail to understand wide variety of methods employed in the practice of clinical microbiology in the laboratory diagnosis of fungal infections Fail to Educate the morphology, genetics, antigenic nature and pathogenesis of fungal infections	Understand he morphology, genetics, antigenic nature and pathogenesis of fungal infections Understands wide variety of methods employed in the practice of clinical microbiology in the laboratory diagnosis of fungal infections Educates the morphology, genetics, antigenic nature and pathogenesis of fungal infections

<p>MK2</p>	<p>Fail to demonstrate knowledge about isolation and identification of medically important fungi</p> <p>Fail to demonstrate Collection/transportation of specimens for fungal identification</p> <p>Fail to demonstrate plating of clinical specimens on media for isolation, purification, identification and quantification purposes.</p> <p>Fail to perform basic laboratory techniques, including Gram-staining/LPCB, culture, organism identification, and antifungal susceptibility testing</p> <p>Fail to isolate and identify of medically important fungi</p>	<p>Demonstrates knowledge about isolation and identification of medically important fungi</p> <p>Demonstrates Collection/transportation of specimens for microbiological investigations</p> <p>Demonstrates plating of clinical specimens on media for isolation, purification, identification and quantification purposes.</p> <p>Performs basic laboratory techniques, including Gram-staining/LPCB, culture, organism identification, and antifungal susceptibility testing</p> <p>Able to isolate and identify medically important fungi</p>
<p>ICS 1</p>	<p>Fail to respond to requests for Microbiology laboratory services including fungal culture in a timely manner and provide accurate results with their interpretations.</p> <p>Fail to respond to requests for consultation in a timely manner and communicates recommendations to the requesting personnel</p> <p>Fail to understand the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments</p> <p>Fail to Maintains effective communication with allied departments.</p> <p>Unable to respond to requests for Microbiology laboratory services in a timely manner and provides accurate results</p>	<p>Responds to requests for Microbiology laboratory services including fungal culture in a timely manner and provide accurate results with their interpretations.</p> <p>Responds to requests for consultation in a timely manner and communicates recommendations to the requesting personnel</p> <p>Understands the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments</p> <p>Maintains effective communication with allied departments.</p> <p>Responds to requests for Microbiology laboratory services in a timely manner and provides accurate results</p>
<p>ICS3</p>	<p>Fail to communicate basic knowledge about standard protocol to be followed for fungal identification in Microbiology laboratory to</p>	<p>Communicates basic knowledge about standard protocol to be followed for fungal identification in Microbiology laboratory to</p>

	<p>technicians and other non-teaching staff</p> <p>Fail to monitor diagnostic activities of technicians in mycology section</p> <p>Fail to supervise the functioning of the mycology laboratory and adherence to standard protocol</p>	<p>technicians and other non-teaching staff.</p> <p>Monitors diagnostic activities of technicians in mycology section</p> <p>Supervise the functioning of the mycology laboratory and adherence to standard protocol</p>
ICS 4	<p>Fail to explain the fungal culture methods effectively in lucid manner engaging both slow- learners and advanced-learners. Fail to interact with students to encourage discussion and to assess their level of understanding</p>	<p>Explains the fungal culture methods effectively in lucid manner engaging both slow-learners and advanced-learners.</p> <p>Interacts with students to encourage discussion and to assess their level of understanding</p>

EPA 9: Should be able to perform and interpret rapid serological tests for bacterial and viral infection	
1. Description of the activity:	<p>The candidate should be</p> <p>Able to explain theoretical aspects of principle, procedure and application of rapid serological tests for bacterial and viral infection</p> <p>Able to perform and interpret rapid serological tests for bacterial and viral infection</p>
2. Most relevant domains of competence:	MK ,ICS, P
3. Competencies within each domain critical to entrustment decisions	MK1.1, MK 1.5 , MK 2.2, MK2.5 , ICS 1.1, ICS1.3, ICS 3.2, ICS 4.2, ICS 4.3; P 2.1, P 3.3
4. Methods of assessment	<p>1. Written Examination</p> <p>2. Work place assessment</p> <p>3. Practical Examination</p> <p>4. seminar</p>

Competency	Pre-Entrustable	Entrustable
MK1	<p>Fail to Understand the application of rapid serological tests for bacterial and viral infections in clinical microbiology</p> <p>Fail to Educate the morphology, genetics, antigenic nature and pathogenesis of bacterial and viral infections</p>	<p>Understands the application of rapid serological tests for bacterial and viral infections in clinical microbiology</p> <p>Educates the morphology, genetics, antigenic nature and pathogenesis of bacterial and viral infections</p>
MK2	<p>Fail to educate to Select appropriate rapid serological tests for bacterial and viral infection</p> <p>Fail to demonstrate knowledge about rapid serological tests for bacterial and viral infection</p>	<p>Educates to Select appropriate rapid serological tests for bacterial and viral infection</p> <p>Demonstrates knowledge about rapid serological tests for bacterial and viral infection</p>
ICS1	<p>Fail to Interact effectively with the allied departments by rendering services like performance of rapid serological tests for the diagnosis of bacterial and viral infections</p> <p>Fail to Maintain effective communication with allied departments.</p> <p>Fail to Respond to requests for rapid serological tests services in a timely manner</p> <p>Fail to provide accurate results of rapid serological tests with their interpretations</p>	<p>Interact effectively with the allied departments by rendering services like performance of rapid serological tests for the diagnosis of bacterial and viral infections</p> <p>Maintains effective communication with allied departments.</p> <p>Responds to requests for rapid serological tests services in a timely manner</p> <p>Provides accurate results of rapid serological tests with their interpretations</p>
ICS3	<p>Fail to communicate basic knowledge about standard protocol of serological tests in Microbiology laboratory to technicians and other non- teaching staff.</p> <p>Fail to monitors diagnostic activities of technicians and other non-teaching staff</p>	<p>Communicates basic knowledge about standard protocol of serological tests in Microbiology laboratory to technicians and other non-teaching staff.</p> <p>Monitors diagnostic activities of technicians and other non-teaching staff</p>
ICS 4	<p>Fail to explain rapid serological tests effectively in lucid manner engaging both slow-learners and advanced-learners.</p>	<p>Explains rapid serological tests effectively in lucid manner engaging both slow- learners and advanced-learners.</p>

	Fail to interact with students to encourage discussion and to assess their level of understanding	Interacts with students to encourage discussion and to assess their level of understanding
P2	Fail to understand and interpret the rapid serological tests appropriate to the patient clinical condition	Understand and interpret the rapid serological tests appropriate to the patient clinical condition
P3	Fail to Maintain confidentiality while performing serological tests which have a social stigma	Maintains confidentiality while performing serological tests which have a social stigma

EPA 10: Should be able to perform various other serology techniques like ELISA, IFA	
1. Description of the activity:	The candidate should be Able to explain theoretical aspects of classification, principle, procedure and application of ELISA and IFA in the diagnosis of infectious diseases. Able to perform and interpret serology techniques like ELISA, IFA in the diagnosis of infectious diseases
2. Most relevant domains of competence:	MK , ICS, P
3. Competencies within each domain critical to entrustment decisions	MK 2.1;ICS 1.1, ICS 1.4, ICS 4.2,ICS 4.3;P 1.4 ,P 3.3
4.Methods of assessment	1. Written Examination 2.Work place assessment 3. Seminar

Competency	Pre-Entrustable	Entrustable
MK2	Fails to Understand the basic as well as advanced knowledge in various microscopes like fluorescent microscope and microscopic techniques used in diagnostic microbiology	Understands the basic as well as advanced knowledge in various microscopes like fluorescent microscope and microscopic techniques used in diagnostic microbiology
ICS 1	Fails to Interact effectively with the allied departments Fails to respond to requests for consultation in a timely manner and communicates recommendations to the requesting personnel.	Interacts effectively with the allied departments Responds to requests for consultation in a timely manner and communicates recommendations to the requesting personnel.
ICS 4	Fail to explain the ELISA and IFA techniques effectively in lucid manner engaging both slow- learners and	Explains the ELISA and IFA techniques effectively in lucid manner engaging both slow-learners

	advanced-learners in the diagnosis of infectious diseases. Fail to interact with students to encourage discussion and to assess their level of understanding	and advanced- learners in the diagnosis of infectious diseases. Interacts with students to encourage discussion and to assess their level of understanding
P1	Fails to demonstrate appropriate use of ELISA and IFA techniques	Demonstrates appropriate use of ELISA and IFA techniques
P3	Fail to Maintain confidentiality while performing serological tests which have a social stigma	Maintains confidentiality while performing serological tests which have a social stigma

EPA 11: Should be able to perform diagnostic tests using automated machines.	
1. Description of the activity:	<p>Candidate should be</p> <p>Able to know and perform the standard operating procedure of automated machines like BACTEC, VITEK, MGIT, GENE XPERT etc</p> <p>Able to know and perform maintenance procedures and calibrations of those instruments</p> <p>Able to know how to maintain the log book for the instrument</p> <p>Able to know about the quality control assessment of the diagnostic tests performed</p> <p>Able to know about the shelf life of the reagents of diagnostic tests</p>
2. Most relevant domains of competence:	MK, PC, ICS, SBP
3. Competencies within each domain critical to entrustment decisions	MK 4.4, PC3.5, ICS2.2, SBP1.2,2.2,2.3
4. Methods of assessment	<p>1. Written Examination</p> <p>2. Work place assessment</p>

Competency	Pre-Entrustable	Entrustable
MK4	Unable to understand and perform the newer automated techniques for early reporting and management	Able to understand and perform the newer automated techniques for early reporting and management
PC3	Not able to apply innovative approaches for investigating emerging and re-emerging infections during outbreak. Provides comprehensive ideas in investigating outbreaks	Able to apply innovative approaches for investigating emerging and re-emerging infections during outbreak. Provides comprehensive ideas in investigating outbreaks
ICS2	Unable to interpret the minimum inhibitory concentration of antibiotics by automated methods Lack of understanding of the antimicrobial stewardship and failure to give suggestions to the clinicians about appropriate choice of antibiotics	Able to interpret the minimum inhibitory concentration of antibiotics by automated methods Understand the antimicrobial stewardship and to give suggestions to the clinicians about appropriate choice of antibiotics
SBP1	Not able to Works effectively as a team member in formulating the principles of Good Record Keeping, document control, instrument maintenance (quality check) and audit reports making.	Works effectively as a team member in formulating the principles of Good Record Keeping, document control, instrument maintenance (quality check) and audit reports making.
SBP2	Unable to understand and explain the Principles of Quality Practices in clinical Microbiology. Unable to demonstrate the ability to follow the SOP and effectively achieve acceptable turnaround time according to the standards.	Understands and explains the Principles of Quality Practices in clinical Microbiology. Demonstrate the ability to follow the SOP and effectively achieve acceptable turnaround time according to the standards.

EPA 12: Should be able to perform Molecular techniques for diagnosing various infectious diseases.	
1. Description of the activity:	Candidate should be, Able to know and perform standard operating procedures of various molecular techniques like conventional PCR, Real-Time PCR, Gel preparation and documentation. Able to know about various quality control measures to prevent contamination while performing the test.
2. Most relevant domains of competence:	MK, PC, SBP, PBLI
3. Competencies within each domain critical to entrustment decisions	MK2.5, MK4.1,4.4,4.5 PC3.5, PBLI1.4
4. Methods of Assessment	1. Work place assessment

Competency	Pre-Entrustable	Entrustable
MK2	Unable to understand and Educate to Select appropriate laboratory tests for pathogen detection/identification and select appropriate anti- infective therapies for a wide range of important infections	Understands and Educates to Select appropriate laboratory tests for pathogen detection/identification and select appropriate anti-infective therapies for a wide range of important infections
MK4	Unable to understand and demonstrate the knowledge and applications about molecular techniques in the laboratory diagnosis of infectious diseases Not able to plan the applications about molecular techniques in the laboratory diagnosis of infectious diseases Not able to explain about strengths and limitations of various molecular techniques	Understand and demonstrate the knowledge and applications about molecular techniques in the laboratory diagnosis of infectious diseases Plan the applications about molecular techniques in the laboratory diagnosis of infectious diseases Explain about strengths and limitations of various molecular techniques
PC3	Not able to apply innovative approaches for investigating emerging and re-emerging infections during outbreak. Provides comprehensive ideas in investigating outbreaks using molecular techniques	Applies innovative approaches for investigating emerging and re-emerging infections during outbreak. Provides comprehensive ideas in investigating outbreaks using molecular techniques

PBLI1	Unable to analyse and interpret the outbreaks management. Perform and interpret the advanced microbiological diagnostic techniques.	Analyse and interpret the outbreaks management. Perform and interpret the advanced microbiological diagnostic techniques.
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EPA 13: Should be able to manage needle stick injury.	
1. Description of the activity:	Candidate should be, Able to advice the health care worker for testing the source to know their HBV,HIV,HCV status Able to identify the HBV vaccination status and titre value of the health care worker Able to explain the prophylactic measures needed or not according to their status Able to explain the importance of early intake of prophylactic measures if needed Able to explain about the importance of personal protective equipments
2. Most relevant domains of competence:	MK, ICS, PC, P
3. Competencies within each domain critical to entrustment decisions	MK 5.1, MK 5.5, ICS 3.4, PC2.4, P1.5
4.Methods of assessment	1. Seminars and presentations on needle stick injury 2. Work place assessment

Competency	Pre-Entrustable	Entrustable
MK 5	Unable to understand the knowledge about hospital acquired infections Lack of knowledge to demonstrate about management of biomedical waste	Understands the knowledge about hospital acquired infections Demonstrate knowledge about management of biomedical waste
ICS 3	Not able to understand and Educate technicians and other non-teaching staff on protocol for safety and quality control in Microbiology laboratory.	Understands and Educates technicians and other non-teaching staff on protocol for safety and quality control in Microbiology laboratory.
PC2	Lack of supervising and educating all the levels of Healthcare workers and especially with those staffs involved in BMW collection and transportation about their needs, responsibilities, personal hygiene, importance of Personal protective equipment's and risks of getting HAI.	Supervises and educates all the levels of Healthcare workers and especially with those staffs involved in BMW collection and transportation about their needs, responsibilities, personal hygiene, importance of Personal protective equipment's and risks of getting HAI.

	Unable to educate and supervise HCW's about the importance of Hepatitis B vaccination and Antibody titter estimation. Analysis the route cause of each Needle sticks injuries and participates in its preventive measures.	Effectively Educates and supervises HCW's about the importance of Hepatitis B vaccination and Antibody titter estimation. Analysis the route cause of each Needle sticks injuries and participates in its preventive measures.
P1	Unable to Perform and lead effectively as an infection control practitioner.	Performs and leads effectively as an infection control practitioner.

EPA 14: Should be able to instruct the technician for handling & disposal of biomedical wastes.	
1. Description of the activity:	Candidate should be, Able to know about current guidelines on biomedical waste management and hospital policy
2. Most relevant domains of competence:	MK, PC, ICS
3. Competencies within each domain critical to entrustment decisions	MK5.5, PC2.3, ICS3.4
4. Methods of assessment	1. Seminars and presentations on biomedical waste management 2. Work place assessment 3. Multiple choice questions

Competency	Pre-Entrustable	Entrustable
MK5	Lack of knowledge to Instruct the technician for handling & disposal of biomedical wastes.	Instruct the technician for handling & disposal of biomedical wastes.
PC2	Not able to demonstrate and Educate the laboratory technicians about various colour coding bins in BMW segregation	Demonstrates and Educates the laboratory technicians about various colour coding bins in BMW segregation
ICS3	Lack of knowledge to educate technicians and other non- teaching staff on standard guidelines of BMW disposal and safety in Microbiology laboratory.	Educates technicians and other non-teaching staff on standard guidelines of BMW disposal and safety in Microbiology laboratory.

EPA 15: Should be aware & able to implement Infection control practices.	
1. Description of the activity:	Candidate should be, Able to know about current guidelines on infection prevention and control and hospital policy
2. Most relevant domains of competence:	MK, PC, ICS , P
3. Competencies within each domain critical to entrustment decisions	MK5.1, PC1.1,PC 1.2, PC 1.3, PC 1.4, PC1.5, ICS3.1,ICS 3.2, P1.5
4.Methods of assessment	1. Audit and assessment

Competency	Pre-Entrustable	Entrustable
MK5	Lack of knowledge to understand about hospital acquired infections and demonstrate knowledge about management of biomedical waste	Understands the knowledge about hospital acquired infections Demonstrate knowledge about management of biomedical waste
PC1	Lack of basic knowledge on common organisms involved in HAI. Unable to explain the chain of infections and definitions of each HAI and its diagnostic criteria according to updated CDC guidelines and Recognize potential for transmission of infection in all clinical settings. Lack of knowledge on evidence based guidelines on hospital acquired infections. Unable to Demonstrate the strategies of Hospital infection prevention and control measures in sequence order. Not able to Maintains effective communication with clinicians and other health care professionals regarding hospital acquired infection, its source identification and preventive measures.	Demonstrate the basic knowledge on common organisms involved in HAI. Explain the chain of infections and definitions of each HAI and its diagnostic criteria according to updated CDC guidelines. Recognize potential for transmission of infection in all clinical settings. Demonstrate knowledge of evidence based guidelines on hospital acquired infections. Demonstrate the strategies of Hospital infection prevention and control measures in sequence order. Maintains effective communication with clinicians and other health care professionals regarding hospital acquired infection, its source identification and preventive measures. Capable of making critical decision in managing Hospital acquired

	Unable to make critical decision in managing Hospital acquired infection and educating all Healthcare workers in preventive strategies.	infection and educating all Healthcare workers in preventive strategies.
ICS3	Uanble to Understand the importance of standard protocol for diagnostic tests, safety and quality control in Microbiology laboratory. Lack of Communication about the basic knowledge on standard protocol in Microbiology laboratory to technicians and other non-teaching staff for infection control	Understands the importance of standard protocol for diagnostic tests, safety and quality control in Microbiology laboratory. Communicates basic knowledge about standard protocol in Microbiology laboratory to technicians and other non-teaching staff for infection control
P1	Unable to Perform and lead effectively as an infection control practitioner.	Performs and leads effectively as an infection control practitioner.

EPA 16:Should be familiar with norms & requirements of NABL, NABH accreditation

1. Description of the activity:	The Resident must understand the criteria required to get NABL, NABH accreditation. One should know to implement the criteria & follow the SOPs in the hospital & laboratory
2. Most relevant domains of competence:	MK ,ICS, SBP, PBLI1, P
3. Competencies within each domain critical to entrustment decisions	MK4.1,MK4.2, MK4.3,MK4.4; ICS 1.1, ICS 1.3, ICS 1.4, ICS 3.1, ICS 3.2, ICS 3.4, ICS 3.5; SBP 1.2, SBP 1.5, SBP 2.3, SBP 2.5 ; PBLI 1.2;P 1.3
4.Methods of assessment	1. Written Examination 2.Work place assessment

Competancy	Pre entrustable	Entrustable
MK4	<p>Fails to recall the effective use of information technology (Computers) in microbiology. Unable to plan, demonstrate & apply the knowledge and applications of Automation in Microbiology. Lack of understanding in the knowledge and applications about molecular techniques in the laboratory diagnosis of infectious diseases.</p>	<p>Recalls the effective use of information technology (Computers) in microbiology. Plan, demonstrate & apply the knowledge and applications of Automation in Microbiology. Understands the knowledge and applications about molecular techniques in the laboratory diagnosis of infectious diseases</p>
ICS1	<p>Fails to interact effectively with the allied departments by rendering services in basic as well as advanced laboratory investigation. Unable to understand the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments. Fails to respond to requests for Microbiology laboratory services in a timely manner and provides accurate results of basic as well as advanced. Microbiology laboratory investigations with their interpretations. Fails to work effectively in inter professional and interdisciplinary research and health care teams. Unable to lead inter-professional and interdisciplinary health care teams to achieve optimal outcomes. Lack of Understanding the importance of information gathering and sharing, and collaborative teamwork with allied departments</p>	<p>Interact effectively with the allied departments by rendering services in basic as well as advanced laboratory investigation. Understands the scopes to expand and upgrade Microbiology laboratory services as per the requirements of allied departments. Responds to requests for Microbiology laboratory services in a timely manner and provides accurate results of basic as well as advanced Microbiology laboratory investigations with their interpretations. Works effectively in inter professional and interdisciplinary research and health care teams. Leads inter-professional and interdisciplinary health care teams to achieve optimal outcomes. Understands the importance of information gathering and sharing, and collaborative teamwork with allied departments</p>
ICS3	<p>Fails to understand, supervise and educate the importance of standard protocol for diagnostic tests, safety and quality control in Microbiology laboratory.</p>	<p>Understands, supervise and educate the importance of standard protocol for diagnostic tests, safety and quality control in Microbiology laboratory.</p>

	<p>Lack of providing consultation to other healthcare institutes and laboratories on laboratory accreditation by training of technicians and other non-teaching staff.</p> <p>Fails to participate in quality control and laboratory accreditation activities</p>	<p>Provides consultation to other healthcare institutes and laboratories on laboratory accreditation by training of technicians and other non-teaching staff.</p> <p>Participates in quality control and laboratory accreditation activities</p>
SBP1	<p>Fails to work effectively as a team member in formulating the principles of Good Record Keeping, document control, instrument maintenance (quality check) and audit reports making. Unable to educate other health care professionals regarding quality control and assurance.</p> <p>Lack of applying innovative approaches in various forms of quality checking, documentation and auditing.</p>	<p>Works effectively as a team member in formulating the principles of Good Record Keeping, document control, instrument maintenance (quality check) and audit reports making.</p> <p>Educates other health care professionals regarding quality control and assurance. Applies innovative approaches in various forms of quality checking, documentation and auditing.</p>
SBP2	<p>Fails to demonstrate the ability to follow the SOP and effectively achieve acceptable turnaround time according to the standards. Unable to organize Faculty development program on quality Practices in clinical Microbiology laboratory.</p>	<p>Demonstrate the ability to follow the SOP and effectively achieve acceptable turnaround time according to the standards.</p> <p>Organizes Faculty development program on quality Practices in clinical Microbiology laboratory.</p>
PBL11	<p>Fails to update knowledge on emerging & reemerging infectious diseases pertaining to the geographical area. Lack of updated knowledge on recent advances in diagnosis of infectious diseases</p>	<p>Updates knowledge on emerging & reemerging infectious diseases pertaining to the geographical area. Updates knowledge on recent advances in diagnosis of infectious diseases</p>
P1	<p>unable to alter the management plan in correlation with the clinical findings, lab investigations appropriately</p>	<p>Able to alter the management plan in correlation with the clinical findings, lab investigations appropriately</p>

EPA 17:Should be able to prepare protocol for investigating any outbreak in area like cholera, typhoid, brucellosis and viral infections	
1. Description of the activity:	The Resident must be able to explain the clinical importance & epidemiology of all diseases. Able to implement & perform the outbreak investigation protocol when needed
2. Most relevant domains of competence:	MK ,PC, P1
3. Competencies within each domain critical to entrustment decisions	MK 3.2, MK 3.5, MK 4.5, MK 5.2; PC 1.5, PC 3.1, PC 3.5; P 1.2
4.Methods of assessment	1. Written Examination 2. Work place assessment

Competency	Pre-Entrustable	Entrustable
MK3	Fails to demonstrate in detail about the epidemiology of important human pathogens and their impact on public health. Unable to interpret the epidemiology of major antimicrobial resistance determinants in important human pathogens and assess the likelihood of such resistance mechanisms being present in a variety of clinical infection scenario	Demonstrate in detail about the epidemiology of important human pathogens and their impact on public health. Interpret the epidemiology of major antimicrobial resistance determinants in important human pathogens and assess the likelihood of such resistance mechanisms being present in a variety of clinical infection scenario
MK4	Unable to perform molecular techniques for diagnosing various infectious diseases	Perform molecular techniques for diagnosing various infectious diseases
MK5	Fails to demonstrate adequate knowledge about how to investigate an infectious outbreak in hospital and community	Demonstrates adequate knowledge about how to investigate an infectious outbreak in hospital and community
PC1	Unable to make critical decision in managing Hospital acquired infection and educating all Healthcare workers in preventive strategies	Capable of making critical decision in managing Hospital acquired infection and educating all Healthcare workers in preventive strategies
PC3	Unable to demonstrate the knowledge on role of laboratories in outbreaks management. Fails to apply innovative approaches for	Able to demonstrate the knowledge on role of laboratories in outbreaks management. Applies innovative approaches for investigating

	investigating emerging and re-emerging infections during outbreak.	emerging and re-emerging infections during outbreak.
P1	Fails to develop knowledge on emerging infectious diseases and their prevention strategies	Develops knowledge on emerging infectious diseases and their prevention strategies

EPA 18:Should be able to carry out systematic research work	
1. Description of the activity:	The Resident should be able understand several Research Methodology and acquire various skills for collaborative research
2. Most relevant domains of competence:	PBLI, ICS
3. Competencies within each domain critical to entrustment decisions	PBLI 2.1, PBLI 2.3, PBLI 2.4, PBLI 2.5; ICS 1.3
4.Methods of assessment	1. Written Examination 2.Work place assessment

Competancy	Pre- entrustable	Entrustable
PBLI2	Unable to understand and apply principles of bioethics and law as they apply to clinical research. Fails to engage in self reflection on utility of research in patient care. Unable to Critically review and interpret the literature with the ability to identify study aims, hypotheses, design, and biases. Fails to evaluate research outcomes through the acquisition of data. Unable to evaluate the research hypothesis and interpret the data with appropriate statistical tools. Lack of Interpretation of the outcomes of clinical / experimental research to improve human health and patient care. Fails to contribute to peer reviewing of clinical research	Understand and apply principles of bioethics and law as they apply to clinical research. Engage in self reflection on utility of research in patient care. Critically reviews and interprets the literature with the ability to identify study aims, hypotheses, design, and biases. Evaluate research outcomes through the acquisition of data. Evaluate the research hypothesis and interpret the data with appropriate statistical tools. Interpret the outcomes of clinical / experimental research to improve human health and patient care. Contributes to peer reviewing of clinical research
ICS1	Fails to work effectively in interprofessional and interdisciplinary research and health care teams.	Works effectively in interprofessional and interdisciplinary research and health care teams.

EPA 19:Should be able to perform as a team worker/ leader	
1. Description of the activity:	The resident must be able to communicate well with co workers & students. One should develop communication and attitudinal skills.
2. Most relevant domains of competence:	ICS, P
3. Competencies within each domain critical to entrustment decisions	ICS 3.3, ICS 3.4, ICS 4.5, P 2.1
4.Methods of assessment	1. Feedback from students/ co workers 2.Work place assessment

Competency	Pre entrustable	Entrustable
ICS3	Fails to work effectively with the laboratory team to provide reliable and accurate diagnostic results in a timely manner. Unable to lead the department in quality control and laboratory accreditation activities.	Works effectively with the laboratory team to provide reliable and accurate diagnostic results in a timely manner. Leads the department in quality control and laboratory accreditation activities
ICS4	Fails to be a Role model for ideal teacher to junior colleagues. Unable to inculcate ethical values and interest in the subject.	Role models for ideal teacher to junior colleagues. Inculcates ethical values and interest in the subject.
P2	Fails to understands the accountability and responsibility of a microbiologist as a health care team member	Understands the accountability and responsibility of a microbiologist as a health care team member

EPA 20:Should be able to teach Microbiology for undergraduate students	
1. Description of the activity:	The Resident must plan, execute and evaluate teaching assignments And learn teaching skills, methods & about resource material
2. Most relevant domains of competence:	ICS , PBLI
3. Competencies within each domain critical to entrustment decisions	ICS4.1, CS4.3, CS4.5 ; PBLI 1.1
4.Methods of assessment	1. Feedback from students 2. Periodic assessment

Competency	Pre Entrustable	Entrustable
ICS4	Fails to understand the importance of relationship development with students, planning and classroom management for undergraduates. Unable to explain the subject effectively in lucid manner engaging both slow-learners and advanced-learners. Fails to interact with students to encourage discussion and to assess their level of understanding. Fails to inculcate ethical values and interest in the subject.	Understands the importance of relationship development with students, planning and classroom management for undergraduates. Explains the subject effectively in lucid manner engaging both slow-learners and advanced- learners. Interacts with students to encourage discussion and to assess their level of understanding. Inculcates ethical values and interest in the subject.
PBLI1	Unable to show commitment in being a life- long learner	Shows commitment in being a life- long learner

Table 5.Mapping of PO,CO, EPA, Competency and Sub-competency with level

General																
EPA		Program outcomes											Domains and levels of competency			
		1	2	3	4	5	6	7	8	9	10	11	12	13		
1.	Should be able to carry out various methods of sterilization process	√			√			√						√	√	MK5.1, MK 5.5;PC 2.1; ICS 3.1, ICS 3.2, ICS 3.4, ICS 4.2, ICS 4.3;P 1.4
2.	Should be able to perform & interpret various staining techniques like gram staining. acid fast staining. negative staining and special staining	√			√		√		√	√	√	√		√	√	MK 2.1, MK 2.3, MK 2.4; ICS 1.3, ICS 1.4, ICS 4.2, ICS 4.3; P 1.4
3.	Should be able to perform & interpret motility of bacteria by hanging drop preparation of clinical specimen.	√			√			√	√	√	√	√		√	√	MK 2.1, MK 2.3, MK 2.4; PC 3.1 ;ICS 1.3, ICS 1.4, ICS 4.2, ICS 4.3; P 1.4
4.	Should be able to maintain both bacterial & fungal stock culture.	√			√											MK 1.1, MK 1.3, MK 2.2, MK 2.3, MK 2.4; ICS 3.2, ICS 3.4
5.	Should be able to carry out antibiotic sensitivity testing as per standard guidelines.	√			√			√						√	√	MK 2.1, MK 2.3, MK 2.5, MK 5.3, MK 5.4; ICS 2.1, ICS 2.2, ICS 2.3, ICS 2.4, ICS 2.5; ICS 3.2, ICS 3.4; ICS 4.2, ICS 4.3; P1.4

6.	Should be able to interpret & report to clinician about peripheral blood smear for parasites.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK 2.1, MK 2.3, MK 2.4; ICS 1.3, ICS 1.4;P1.4
7.	Should be able to identify the pathogenic bacteria by aerobic and anaerobic culture methods.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK1.1, MK 2.2; ICS1.3, ICS 1.4, ICS 1.1, ICS 2.1, ICS 2.2, ICS 2.3, ICS 2.4, ICS 2.5, ICS 3.2, ICS 3.4, ICS 4.2, ICS 4.3
8.	Should be able to perform & confirm the identification of fungus by routine fungal culture of clinical specimen.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK 1.1, MK 1.5, MK 2.2, MK 2.3; ICS1.1 ICS,1.3, ICS 1.4, ICS 3.2, ICS 3.3, ICS 4.2, ICS 2.3
9.	Should be able to perform and interpret rapid serological tests for bacterial and viral infection	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK1.1, MK 1.5, MK 2.2, MK2.5, ICS 1.1, ICS1.3, ICS 3.2, ICS 4.2, ICS 4.3; P 2.1, P 3.3
10.	Should be able to perform various other serology techniques like ELISA, IFA.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK 2.1; ICS 1.1, ICS 1.4, ICS 4.2, ICS 4.3; P 1.4, P 3.3
11.	Should be able to perform diagnostic tests using automated machines.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK 4.4, PC 3.5, ICS2.2, SBP 1.2,2.2,2.3
12.	Should be able to perform Molecular techniques for diagnosing various infectious diseases.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	MK 2.5, MK 4.1,4.4,4.5 PC 3.5, PBLI 1.4

13.	Should be able to manage needle stick injury.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	MK 5.1,5.5, ICS 3.4, PC 2.4, P 1.5
14.	Should be able to instruct the technician for handling & disposal of biomedical wastes.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	MK 5.5, PC 2.3, ICS 3.4
15.	Should be aware & able to implement Infection control practices	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	MK 5.1, PC 1.1, PC 1.2, PC 1.3, PC 1.4, PC1.5, ICS 3.1, ICS3.2, P 1.5
16.	Should be familiar with norms & requirements of NABL, NABH accreditation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	MK4.1,MK4.2, MK4.3,MK4.4; ICS 1.1, ICS 1.3, ICS 1.4, ICS 3.1, ICS 3.2, ICS 3.4, ICS 3.5; SBP 1.2, SBP 1.5, SBP 2.3, SBP 2.5 ; PBLI 1.2; P 1.3
17.	Should be able to prepare protocol for investigating any outbreak in the area like cholera, typhoid, brucellosis and viral infections.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	MK 3.2, MK 3.5, MK 4.5, MK 5.2; PC 1.5, PC 3.1, PC 3.5; P 1.2
18.	Should be able to carry out systematic research work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	PBLI 2.1, PBLI 2.3, PBLI 2.4, PBLI 2.5; ICS 1.3
19.	Should be able to perform as a team worker / leader.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ICS 3.3, ICS 3.4, ICS 4.5, P 2.1
20.	Should be able to teach Microbiology for undergraduate medical students.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	ICS4.1, CS4.3, CS4.5 ; PBLI 1.1

8.2 Summative Assessment

i.e., assessment at end of training Theory Examination (400 marks)

Duration : Each paper 3 hours

Paper I : General Microbiology and Immunology (100 marks)

Paper II : Systematic Bacteriology (100 marks)

Paper III : Parasitology, Virology and Mycology (100 marks)

Paper IV : Applied Microbiology and Recent advances (100 marks)

Practical Examination (200 marks)

Duration:2 days

The examination will consist of the following exercises conjointly conducted and evaluated by **FOUR examiners, of which two are internals and other two are externals.**

Exercise	Marks
1. Bacteriological Techniques (Pure culture)	
Isolation and identification of bacteria given in pure culture	50
2. Clinical Bacteriology (Mixed culture)	
Isolation and discussion on from clinical case	30
3. Mycology	
Identification of two fungal cultures	20
4. Immunology	
Major serology – Widal test, VDRL	10
Minor serology – ASO, CRP, RF, RPR	10
5. Parasitology	20
* Examination of stool for ova and cysts – Direct examination Concentration technique	
6. Virology	10
Serological test- ELISA/ICT	
7. Animal experiment/HICC case discussion	10
Animal experiment – handling and discussion	
8. Slides	20
Stained smear Tissue section (related to Microbiology)	
9. Pedagogy	20
Total	200

B. Viva-voce Examination (100 marks)

The oral examination consists of questioning on the dissertation and overall subject matter. It will be conducted by all the four examiners as in the case of the practical examination

Total marks for PG Examination

Marks qualifying for a pass	Maximum marks	Qualifying for a pass (50% marks)
A. Theory	400	200
B. Practicals	200	100
C. Viva - voce	100	no minimum
D. Dissertation (approved / not approved)	- Nil -	approved
GRAND TOTAL:	700	350

Pattern of University Practical Examination (2 days)

Day	Morning	Afternoon
Day – 1	Pure culture Mixed culture Mycology	Parasitology Serology - Major - Minor
Day – 2	Pure culture (continuation) Mixed culture (continuation) Slides	Virology Animal experiment /HICC Case discussions Pedagogy Viva voce

9. Blue print of Weight of the system

Paper I (100 marks) General Microbiology & Immunology							
	Topic	Weightage	Knowledge/ Recall	Understanding	Application	Marks Allotted	No. of Question
1	General Microbiology	50%	10%	20%	20%	50	5
2	Immunology	50%	10%	20%	20%	50	5
	Total Weightage	100%	20%	40%	40%	100	10

Paper II (100 marks) Systematic Bacteriology							
	Topic	Weightage	Knowledge/ Recall	Understanding	Application	Marks Allotted	No. of Question
1	Gram positive and gram negative cocci	10%		10%		10	1
2	Gram positive bacilli	10%		10%		10	1
3	Gram negative bacilli	30%	10%	10%	10%	30	3
4	Mycobacteria and Mycoplasma, Rickettsiae, chlamydia	20%		10%	10%	20	2
5	Spirochaetes	10%			10%	10	1
6	Miscellaneous bacteria	20%	10%		10%	20	2
	Total Weightage	100%	20%	40%	40%	100	10

Paper III (100 marks)							
Parasitology, Virology and Mycology							
	Topic	Total Weightage	Knowledge/ Recall	Understanding	Application	Marks Allotted	No. of Question
1	Parasitology	40%	10%	20%	10%	40	4
2	Virology	40%	10%	10%	20%	40	4
3	Mycology	20%		10%	10%	20	2
	Total Weightage	100%	20%	40%	40%	100	10

Paper IV (100 marks)							
Applied Microbiology & Recent Advances							
	Topic	Weightage	Knowledge/ Recall	Understanding	Application	Marks Allotted	No. of Question
	Applied Microbiology	70%	10%	10%	50%		
1	Bacteriology	20%	-	-	20%	20	2
2	Virology	20%	-	-	20%	20	2
3	HAI, Infection control & Biomedical Waste Management	20%	-	10%	10%	20	2
4	Prevention of infection, Disease Control programs.	10%	10%	-	-	10	1
	Recent Advances	30%	20%	-	10%		
1.	Advanced & Newer laboratory techniques	20%	10%		10%	10	1
2	New guidelines, Newer vaccines	10%	10%			10	1
	Total Weightage	100%	30%	10%	60%	100	10

10. Model Question Paper for MD Microbiology

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MD – MICROBIOLOGY

MODEL QUESTION PAPER

PAPER I

(General Microbiology & Immunology)

Time: 3 Hours

Answer all the questions

Max. Marks: 100

Draw diagrams wherever necessary

Write Short Essays on

(10X10 =100)

1. Discuss the methods of testing the efficiency of disinfectants.
2. Explain the principle and applications of Fluorescent Microscopy.
3. Describe the mechanisms of drug resistance in bacteria.
4. Biosafety in diagnostic microbiology laboratory.
5. Describe the bacterial virulence factors and their role in pathogenicity.
6. Immunomodulators
7. Screening procedures for the selection of donor for Organ transplantation
8. Write different theories of immune response
9. Complement in health and disease
10. Immunochromatography – Principles , Procedure and applications

SRI BALAJI VIDYAPEETH
MD – MICROBIOLOGY
MODEL QUESTION PAPER

PAPER II

(Systematic Bacteriology)

Time: 3 Hours

Answer all the questions

Max. Marks: 100

Draw diagrams wherever necessary

Write Short Essays on:

(10X10 =100)

1. Discuss the Pathogenesis and laboratory diagnosis of Group B Streptococcal infections
2. Describe in detail pathogenesis and laboratory diagnosis of *Clostridium welchii*
3. Classify Nonfermenting Gram negative bacilli. Discuss the laboratory diagnosis of infections caused by them.
4. Helicobacter pylori
5. Discuss the laboratory diagnosis of Rickettsial diseases
6. Describe, pathogenesis and laboratory diagnosis of *V.cholerae*
7. Pathogenesis and Laboratory diagnosis of Leptospirosis
8. Parvobacteria
9. Pleuropneumonia like organisms (PPLO)
10. Describe the bacterial vaccines included in the immunization schedule

SRI BALAJI VIDYAPEETH

MD - MICROBIOLOGY

MODEL QUESTION PAPER

PAPER III

(Parasitology, Virology and Mycology)

Time: 3 Hours

Answer all the questions

Max. Marks: 100

Draw diagrams wherever necessary

Write Short Essays on:

(10X10 =100)

1. Describe in detail pathogenesis and laboratory diagnosis of Rabies.
2. Classify Antifungal agents and describe the antifungal susceptibility testing in the laboratory.
3. Classify Herpes viruses. Discuss the pathogenesis and laboratory diagnosis of EBV
4. Neurocysticercosis
5. Laboratory diagnosis and complications of Falciparum malaria
6. Parasitic infections of CNS.
7. Pathogenesis and laboratory diagnosis of lymphatic filariasis.
8. Explain tissue culture and detection of viral growth in cell lines in detail
9. Viral infection in post- transplantation patients
10. Describe opportunistic fungal infection in AIDS patient

SRI BALAJI VIDYAPEETH
MD – MICROBIOLOGY
MODEL QUESTION PAPER
PAPER IV

(Applied Microbiology & Recent Advances)

Time: 3 Hours

Answer all the questions

Max. Marks: 100

Draw diagrams wherever necessary

Write Short Essays on:

(10X10 =100)

1. MALDI TOF
2. Evaluation of CLABSI
3. Investigation and management of an outbreak of H1N1 influenza
4. PCR and their application in diagnostic Microbiology.
5. Teratogenic viruses
6. Biomedical waste management.
7. Automation in diagnostic Microbiology.
8. Recent methods in the laboratory diagnosis of Tuberculosis
9. Describe the NACO guidelines for testing and treatment of HIV
10. Malarial vaccines.

11. Recommended Reading

A. Text Books

1. Collee J G Mackie and Mc cartney Practical Medical Microbiology latest edition
2. Bailey and Scott's Diagnostic Microbiology. 9th ed. CV Mosby, St. Louis, latest edition.
3. Koneman EW, Allen SD, Schreckenber PC, Winn WC (Eds): Atlas and Textbook of Diagnostic Microbiology. 4th ed. JB Lippincott, Philadelphia, latest edition
4. Murray PR, Baron EJ, Pfaller MA, Tenover PC, and Tenover PC (Eds): Manual of Clinical Microbiology. 6th ed. American Society for Microbiology, Washington, DC, latest edition.
5. Latest edition of Bergey's manual
6. Daniel P. Stites, Abba I. Terr, Tristram G. Parslow. Medical immunology. 10th edition, Mc Graw Hill.
7. Brooks, Geo F Jawetz Medical Microbiology latest edition McGraw Hill.
8. Mandell, Douglas & Bennetts. Principles and practice of Infectious Diseases. Vol. I & II.
9. Collier, Leslie Topley and Wilson's Microbiology and microbial infections Vol 1, 2, 3, 4,6,7 latest edition
10. Ananthanarayan&Paniker's Textbook of Microbiology, latest edition. Orient Longman, India; 2009.
11. Jagdish Chander, Text book of Medical Mycology, latest edition, Mehta Publishers, latest edition
12. Parasitology – K.D.Chatterjee, latest edition
13. Textbook of Medical Parasitology – P.Chakraborty, latest edition
14. Anaissie Elias J. Clinical Mycology, Churchill Livingstone latest edition.
15. Parija SC. Textbook of Medical Parasitology . latest edition. All India Publishers and Distributors, New Delhi. India
16. Roitt Ivan M, Immunology latest edition Blackwell Science
17. Principles of internal medicine by Harrison , latest edition
18. Harrison Infectious Disease, Latest Edition
19. Park and Park's textbook of Preventive and Social medicine. latest edition.
20. Cedric Mims, Hazel M Dockrell, Richard V Goering, Ivan Roitt, Derek Wakelin, Mark Zukerman. Medical Microbiology. 3rd edition. Mosby, 2004.

21. Manson's, Tropical Disease
22. Zuckerman AJ, Clinical Virology
23. Textbook of Hospital Infection Control

B. Journals

1. Indian journal of Medical Microbiology
2. Journal of infectious Diseases
3. American Journal of Clinical Microbiology
4. Indian Journal of Pathology & Microbiology.
5. Annual Review of Microbiology.
6. Indian Journal of Medical Research.
7. Indian Journal of Immunology.
8. Journal of Tropical Medicine.
9. New England Journal of Medicine.
10. Clinical Microbiological Reviews.
11. Journal of Medical Microbiology
12. Journal of Hospital Infection
13. Journal of Clinical Virology
14. BMJ- Infectious Disease
15. PLOS-Pathogens
16. Antimicrobial Agents and Chemotherapy
17. Emerging Infectious Diseases

12. Annexures

Annexure 1

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 1 2 3	Satisfactory 4 5 6	More Than Satisfactory 7 8 9	Remarks
1	Journal based / recent advances learning				
2	Patient based /Laboratory or Skill based learning				
3	Self directed learning and teaching				
4	Departmental and inter departmental 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 post graduate student is strongly recommended.

Signature of Assessee

Signature of Consultant

Signature of HOD

**Annexure-2: Entrustable Professional
Activities Assessment Mahatma Gandhi
Medical College & Research Institute
Department of Microbiology
Entrustable Professional Activities Assessment Form MD Microbiology PG Student**

Name of the PG student:

UNI No:

Levels of competence:

- **Level 0:** No awareness
- **Level I:** Knowledge only; can observe
- **Level II:** Can do under strict supervision
- **Level III:** Can do under loose supervision
- **Level IV:** Can do independently
- **Level V:** Has expertise to teach others

14.	Should be able to instruct the technician for handling & disposal of biomedical wastes.																			
15.	Should be aware & able to implement Infection control practices																			
16.	Should be familiar with norms & requirements of NABL, NABH accreditation																			
17.	Should be able to prepare protocol for investigating any outbreak in the area like cholera, typhoid, brucellosis and viral infections.																			
18.	Should be able to carry out systematic research work																			
19.	Should be able to perform as a team worker / leader.																			
20.	Should be able to teach Microbiology for undergraduate medical students.																			

Date:

SIGNATURE OF HOD