



MGM INSTITUTE OF HEALTH SCIENCES

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

Grade 'A' Accredited by NAAC

Sector-01, Kamothe, Navi Mumbai -410 209

Tel 022-27432471, 022-27432994, Fax 022 -27431094

E-mail: registrar@mgmuhs.com; Website : www.mgmuhs.com

COMPETENCY BASED MEDICAL EDUCATION

(CBME)

(with effect from 2020-2021 Batches)

Curriculum for Doctor of Medicine Microbiology

Approved as per AC-49/2024, Dated 25/04/2024

Amended History

1. Approved as per AC - 41/2021, Resolution No.4.21; Dated 27/08/2021.
2. Approved as per AC - 49/2024, [Resolution No.4.13, Annexure 44A & 44C]; Dated 25/04/2024.

Item 9: To restructure the Curriculum for MD Microbiology as per Postgraduate training guidelines from batch appearing in university exams in 2023 onwards

MD Microbiology

Curriculum and Syllabus (CBME)

COURSE OVERVIEW:

Duration of the Course

The period of certified study and training for the Post-Graduate MD MICROBIOLOGY shall be Three Academic years.

Attendance

All students joining the postgraduate training program shall work as full time residents during the period of training, attending not less than 80% (eighty percent) of the training during each calendar year, and will be given full time responsibility, assignments and participation in all facets of the educational process.

The period of training for obtaining the degrees shall be three completed years including the period of examination.

COURSE CONTENTS (SYLLABUS)

Paper I: General Microbiology

1. History of microbiology
2. Microscopy
3. Bio-safety including universal containment, personal protective equipment for biological agents
4. Physical and biological containment
5. Isolation precautions including standard precautions and transmission based precautions
6. Sterilization, disinfection and lyophilization
7. Morphology of bacteria and other microorganisms
8. Nomenclature and classification of microorganisms
9. Normal flora of human body

10. Growth and nutrition of bacteria
11. Bacterial metabolism
12. Bacterial toxins
13. Bacteriocins
14. Microbiology of hospital environment
15. Microbiology of air, milk and water
16. Host-parasite relationship
17. Antimicrobial agents and mechanisms drug resistance
18. Bacterial genetics and bacteriophages
19. Molecular genetics relevant for medical microbiology
20. Quality assurance and quality control in microbiology
21. Accreditation of laboratories

Immunology

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

19. Measurement of immunological parameters
20. Immunological techniques
21. Immunopotential and immunomodulation

Paper II: Systematic bacteriology

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

Mycology

1. General characteristics and classification of fungi
2. Morphology and reproduction of fungi
3. Isolation and identification of fungi
4. Tissue reactions to fungi

5. Yeasts and yeast like fungi of medical importance including Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces etc.
6. Mycelial fungi of medical importance including Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra, other dematiaceous hyphomycetes and other Hyalohyphomycetes etc.
7. Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffei etc.
8. Dermatophytes
9. Fungi causing Mycetoma, Chromoblastomycosis, Occulomycosis and Otomycosis.
10. Pythium insidiosum
11. Prototheca
12. Pneumocystis jirovecii infection
13. Rhinosporidium seeberi and Lacazia loboi (Loboaloboi)
14. Laboratory contaminant fungi
15. Mycetism and mycotoxicosis
16. Antifungal agents and in vitro antifungal susceptibility tests.

Paper III: Virology

1. General properties of viruses
2. Classification of viruses
3. Morphology: Virus structure
4. Virus replication
5. Isolation and identification of viruses
6. Pathogenesis of viral infections
7. Genetics of viruses
8. DNA viruses of medical importance including Pox viruses, Herpes viruses, Adenoviruses, Hepadna virus, Papova and Parvo viruses etc.
9. RNA viruses of medical importance including Enteroviruses, Toga viruses, Flavi viruses, Orthomyxo viruses, Paramyxo viruses, Reo viruses, Rhabdoviruses, Arena viruses, Bunya viruses, Retro viruses, Filo viruses, Human immune deficiency virus, Arbo viruses, Corona viruses and Covid Pandemic, Calci viruses etc.
10. Slow viruses including prions
11. Unclassified viruses
12. Hepatitis viruses

13. Virioids, prions

14. Vaccines and anti-viral drugs.

Parasitology

1. General characters and classification of parasites.
2. Methods of identification of parasites
3. Protozoan parasites of medical importance including Entamoeba, Free living amoebae, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma, Sarcocystis, Cryptosporidium, Microsporidium, Cyclospora, Babesia, Balantidium, etc.
4. Helminthology of medical importance including those belonging to Cestoda (Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipylidium, Multiceps etc.), Trematoda (Schistosomes, Fasciola, Fasciolopsis, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis etc.) and Nematoda (etc.)
5. Entomology: common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myiasis.
6. Anti-parasitic agents.

Paper IV: Applied Microbiology

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

11. Automation in Microbiology
12. Molecular techniques in the laboratory diagnosis of infectious diseases
13. Statistical analysis of microbiological data and research methodology
14. Animal and human ethics involved in microbiological work.
15. Safety in laboratory and Laboratory management

PRACTICALS (SKILLS)

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	ANA by Immunoblot	5	5	--
	7	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 blood smear	-	10	-
	2	Stool wet mount for R/M	--	--	30
	3	Stool concentration techniques	--	--	5
	4	Modified ZN staining for <i>C. parvum</i>	--	--	2
Serology/ Immunology	1	Phlebotomy & separation of serum	--	--	5
	2	Operation & maintenance of mini-VIDAS	--	--	20
	3	Operation & maintenance of ELISA reader & washer	--	--	20
		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	ANA by Immunoblot	--	--	10
7	IQC-serology	--	--	5	

3rd 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 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	ANA by Immunoblot	--	--	10
	7	IQC-serology	--	--	5

PG TEACHING TOPIC IN MICROBIOLOGY

Sr. Nos	Topic	Section
1	Historical aspects of Microbiology	General Microbiology
2	Structure of bacteria	General Microbiology
3	Bacterial growth, nutrition metabolism	General Microbiology
4	Microscopes	General Microbiology
5	Disinfection	General Microbiology
6	Culture methods	General Microbiology
7	Bacterial genetics and mutation	General Microbiology
8	Bacterial gene transfer	General Microbiology
9	Infection	General Microbiology
10	Immunity	Immunology
11	Immunoglobulins	Immunology
12	Precipitation	Immunology
13	Agglutination	Immunology
14	ELISA	Immunology
15	Complement	Immunology
16	Anaphylaxis	Immunology
17	Autoimmunity	Immunology
18	Tumour immunity	Immunology
19	Transplantation immunity	Immunology
20	MRSA	Systemic Bacteriology
21	Streptococcal infections	Systemic Bacteriology
22	Gas gangrene	Systemic Bacteriology
23	Salmonellosis	Systemic Bacteriology
24	Leptospirosis	Systemic Bacteriology
25	Rickettial diseases	Systemic Bacteriology
26	PUO	Systemic Bacteriology
27	Diarrheal diseases	Systemic Bacteriology
28	STDs	Systemic Bacteriology
29	UTI	Systemic Bacteriology

30	Superficial Mycosis	Mycology
31	Deep mycosis	Mycology
32	Opportunistic mycosis	Mycology
33	Hepatitis B	Virology
34	Enteroviruses	Virology
35	Retroviruses	Virology
36	Oncogenic viruses	Virology
37	Arboviruses	Virology
38	Malaria	Parasitology
39	Toxoplasmosis	Parasitology
40	Lymphatic filariasis	Parasitology
41	Tapeworm and Cysticercosis	Parasitology
42	Leishmaniasis	Parasitology
43	Free living amoebae	Parasitology
44	Healthy gene	Bioethics
45	Universal principles	Bioethics
46	Outbreak report	Bioethics
47	Drug resistance minimization	Bioethics
48	Sterilization Techniques	Bioethics
49	Biosafety and Biohazard	Bioethics
50	Environmental ethics	Bioethics
51	CBNAAT	Molecular
52	Line Probe Assay	Molecular
53	Polymerase Chain Reaction (PCR)	Molecular
54	Automated Blood culture system	Miscellaneous
55	Vaccines	Miscellaneous
56	Bacteriology of Water	Miscellaneous
57	Bacteriology of Air	Miscellaneous
58	Bacteriology of Food	Miscellaneous
59	Normal microbial flora	Miscellaneous
60	Emerging and Reemerging Infections	Miscellaneous
61	Role of RT PCR in diagnosis of SARS COV 2	Covid Pandemic
62.	RAT and other tests for diagnosis of SARS	Covid Pandemic

	COV 2	
63.	Covid Vaccines	Covid Pandemic
64.	Post Covid Microbial complications	Covid Pandemic
65.	Setting up a biosafety level 4 lab for Covid and other viral infections	Covid Pandemic

Emergency duty

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

MAINTENANCE OF LOG BOOK

Each post graduate student shall maintain a record of skills acquired during the three years of training period, in various sections. The log book to be submitted at the time of practical examination.

It is must that a post graduate student during the course to present one poster presentation and to read one paper at a national /state conference and to present one research paper which can be published/accepted for publication

TEACHING/LEARNING METHODS:

Learning in M.D. (Microbiology) will essentially be self learning. Following teaching/learning methods shall be followed

Group teaching sessions:

1. Journal clubs
2. Subject seminar presentation
3. Group discussion
4. Slide seminars
5. Presentations of the finding of an exercise on any of the sub-specialties
6. Preparation in CME programs and conferences
7. Didactic PG lectures

Hands on experience (practical training)

Practical shall be imparted by posting the students in various sub- specialities (sections) as detailed in the intrinsic and extrinsic rotations. Students shall be actively involved in day to day working of all the sections. He/she will be trained under direct supervision of the teachers in all the aspects of Clinical Microbiology and applied aspects of laboratory medicine including handling and processing of the specimens

Assessments and Evaluation:

A. INTERNAL EXAMINATION

Portion:

1 st Internal Exam	2 nd Internal Exam	Prelims
<p>GENERAL</p> <p>MICROBIOLOGY:</p> <ol style="list-style-type: none"> History and Pioneers in Microbiology Microscopy Nomenclature and classification of microbes Morphology of bacteria and other micro-organisms Growth and Nutrition of bacteria Bacterial metabolism Sterilization and disinfection Culture media and culture methods Identification of bacteria Bacterial toxins Bacterial antagonism : Bacteriocins Bacterial genetics Gene cloning Antibacterial substances used in the treatment of infections and drug resistance in bacteria Bacterial ecology - Normal flora of human body, Hospital environment, Air, Water and Milk Host-parasite relationship 	<p>IMMUNOLOGY :Clinical</p> <ol style="list-style-type: none"> Hypersensitivity Immunodeficiency Auto-immunity Immune tolerance Transplantation immunity Tumour immunity Immunoprophylaxis and immunotherapy Measurement of immunity 	<p>GENERAL</p> <p>MICROBIOLOGY & IMMUNOLOGY:</p> <p>All</p>

<p>IMMUNOLOGY :</p> <ol style="list-style-type: none"> 1. Innate and acquired immunity 2. Antigens 3. Immunoglobulins 4. Antigen and antibody Reactions 5. Complement System 6. The normal immune system: structure and function 7. Immune Response 	<p>SYSTEMATIC BACTERIOLOGY</p> <ol style="list-style-type: none"> 1. <i>Streptococcus and Lactobacillus</i> 2. <i>Staphylococcus and Micrococcus</i> 3. <i>Pseudomonas</i> 4. <i>The Enterobacteriaceae</i> 5. <i>Mycobacteria</i> 6. <i>Corynebacterium</i> and other <i>Coryneform</i> bacteria 7. <i>Vibrios, Aeromonas, Plesiomonas, Campylobacter & Spirillum</i> 8. <i>Neisseria, Branhamella & Moraxella</i> 9. <i>Haemophilus and Bordetella</i> <i>Bacillus</i>: the aerobic spore-bearing bacilli 11. <i>Clostridium</i>: the spore-bearing anaerobic bacilli 12. Non-sporing anaerobe 10. <i>The Spirochaetes</i> 	<p>SYSTEMATIC BACTERIOLOGY (2nd year) : plus</p> <ol style="list-style-type: none"> 1. <i>Actinomycetes, Nocardia and Actinobacillus</i> 2. <i>Erysipelothrix and Listeria</i> 3. <i>The Bacteroidaceae: Bacteroides, Fusobacterium and Leptotrichia</i> 4. <i>Chromobacterium, flavobacterium, Acinetobacter and Alkaligenes</i> 5. <i>Pasteurella, Francisella</i> 6. <i>Brucella</i> 7. <i>Chlamydia</i> 8. <i>Rickettsiae</i> 9. <i>Mycoplasmatales: Mycoplasma, Ureaplasma and Acholeplasma</i> <p>Miscellaneous bacteria</p>
<p>MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES</p> <ol style="list-style-type: none"> 1. Normal Microbial flora 2. Epidemiology of infectious diseases 3. Hospital acquired infections & Hospital waste disposal 4. Bacteriology of water milk and air 	<p>VIROLOGY:</p> <ol style="list-style-type: none"> 1. The nature of viruses 2. Classification of viruses 3. Morphology: virus structure 4. Virus replication 5. The genetics of viruses 6. The pathogenicity & lab diagnosis of viruses 7. Epidemiology of viral infections 8. Anti-viral drugs 9. Bacteriophages 10. <i>Herpesviruses</i> 11. <i>Paramyxoviruses</i> 12. <i>Influenza virus</i> 13. <i>Hepatitis viruses</i> 14. <i>Rabies virus</i> 15. <i>Human immune deficiency viruses</i> 16. <i>SARS COV 2</i> 	<p>VIROLOGY (2nd year): plus</p> <ol style="list-style-type: none"> 1. Vaccines 2. <i>Pox viruses</i> 3. <i>Vesicular viruses</i> 4. <i>Togaviruses</i> 5. <i>Bunyaviruses</i> 6. <i>Arenaviruses</i> 7. <i>Marburg and Ebola viruses</i> 8. <i>Rubella virus</i> 9. <i>Orbiviruses</i> 10. Respiratory diseases : <i>Rhinoviruses, adenoviruses and corona viruses</i> 11. <i>Enteroviruses; Polio, Echo and Coxsackieviruses</i> 12. Other enteric viruses 13. Slow viruses 14. Oncogenic viruses 15. Teratogenic viruses

	<p>PARASITOLOGY:</p> <ol style="list-style-type: none"> 1. General Parasitology 2. Protozoan parasites of medical importance: <i>Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium</i> 	<p>PARASITOLOGY (2nd year): plus</p> <ol style="list-style-type: none"> 1. Protozoan parasites of medical importance: <i>Toxoplasma, Sarcocystis, Cryptosporidium, Babesia, Balantidium</i> etc. 2. Helminthology: All those medically important helminthes belonging to Cestoda, Trematoda and Nematoda. 3. Cestodes: <i>Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipylidium, Multiceps</i> etc. 4. Trematodes: <i>Schistosomes, Fasciola, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis</i> etc. 5. Nematodes: <i>Trichuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus</i>, etc. 6. Ecto-parasites: Common arthropods and other vectors viz., Mosquito, Sand fly, Ticks, Mite, Cyclops
	<p>MYCOLOGY</p> <ol style="list-style-type: none"> 1. The morphology and reproduction of fungi 2. Classification of fungi 3. <i>Dermatophytes</i> 4. <i>Candida</i> 5. <i>Aspergillus</i> 	<p>MYCOLOGY (2nd year): plus</p> <ol style="list-style-type: none"> 1. Contaminant and opportunistic fungi 2. Fungi causing superficial mycoses 3. Fungi causing subcutaneous mycoses 4. Fungi causing systemic infections 5. Anti-mycotic agents

**MICROBIOLOGY
APPLIED TO
TROPICAL MEDICINE
AND RECENT**

ADVANCES

1. Infections of various organs and systems of human body
2. Molecular genetics as applicable to microbiology
3. Vaccinology: principle, methods of preparation, administration of vaccines.
4. Bio-terrorism

COVID PANDEMIC

1. Role of RT PCR in diagnosis of SARS COV 2
2. RAT and Other tests in diagnosis of SARS COV 2
3. Covid Vaccines
4. Microbial complications on post covid patients

**ALLIED BASIC
SCIENCES**

(a) Biochemistry: Basic understanding of biochemistry as applied to immunological/ molecular methods for study of microbial diseases and pathogenesis of infections.

1. Protein purification and estimation
2. Protein estimation
3. Nucleic acid purification and characterization
4. Agarose and polyacrylamide gelelectrophoresis - principles
5. Ultracentrifugation –

		<p>principles</p> <p>6. Column chromatography – principles</p> <p>(b) Molecular biology: Basic knowledge as applicable to molecular diagnostics and molecular epidemiology.</p> <ol style="list-style-type: none"> 1. Recombinant DNA technology 2. Southern, northern and western blotting 3. DNA amplification techniques 4. Diagnostic PCR, different methods of PCR product detection (liquid hybridization, ELISA). 5. Genotyping of microbes and viruses <p>(c) Pathology: (as applied to Microbiology) Basic knowledge of</p> <ol style="list-style-type: none"> 1. Inflammation and repair 2. Intercellular substances and reaction 3. Pathological changes in the body in bacterial, viral, mycotic and parasitic infections <p>Demonstration of pathogen in tissue section</p>
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Internal Exam Pattern:

Internal exam will be held every year in the month of March/April for all PG students

1st year exam	
Theory (one paper) of 100 marks	BAQs :10/11 questions (10Marks each) Total : 100 marks
Practical 100 marks	Gram stain: 15 marks ZN stain : 15 marks Serology : 20 marks Grand viva : 50 marks Total : 100 marks
2nd year exam	
Theory (two papers) 100 marks each	I Immunology and Systemic Bacteriology II Virology, Parasitology and Mycology BAQs :10/11 questions (10Marks each) Total : 200 marks
Practical	Bacteriology long exercise : 40 marks Bacteriology short exercise : 20 marks Mycobacteriology: 10 Marks Serology : 20 marks Fungal culture : 20 marks Virology exercise : 20 Marks Stool examination: 20 Marks

	<p>Grand viva : 50 marks</p> <p>Total : 200 Marks</p>
Prelim exam (3rd year exam)	
<p>Theory (four papers) 100 marks each (Same as University Exam)</p>	<p>I General Microbiology, Immunology and Basic Sciences</p> <p>II Systemic Bacteriology</p> <p>III Mycology , virology and Parasitology</p> <p>IV Applied Microbiology& Recent advances</p> <p>Total : 400 marks</p>
<p>Practical (Same as University exam)</p>	<p>Bacteriology Long Case- 60 Marks</p> <p>Bacteriology Short Case- 40 Marks</p> <p>Virology exercise- 40 Marks</p> <p>Parasitology Exercise -40 Marks</p> <p>Mycology Exercise- 40 Marks</p> <p>Serology Exercise- 40 marks</p> <p>Pedagogy -10 Marks</p> <p>Identification of Slides- 30 Marks</p> <p>Grand viva- 100 Marks</p> <p>Total : 400 marks</p>

B. UNIVERSITY EXAMINATION

Final university examination shall be at the end of three years. Obtaining a minimum of 50% marks in theory as well as practical separately shall be mandatory for passing examination as a whole.

1. **THEORY:** there shall be four theory papers of 100 marks each. Each paper shall be of 3 hours duration.

Paper 1 General Microbiology, Immunology and Basic Sciences

Paper 2 Systemic bacteriology

Paper 3 Mycology, Virology and Parasitology

Paper 4 Applied Microbiology and Recent advances

2. PRACTICAL SCHEME

Sr No	EXERCISE/VIVA	MAXIMUM MARKS
A)	Long Exercise Bacteriology	60
B)	Short Exercises	
	Short Exercise Bacteriology	40
	Virology /Molecular Exercise	40
	Mycology Exercise	40
	Parasitology Exercise	40
	Serology Exercise	40
	Identification Of Slides	30
	Microteaching/ Pedagogy	10
C)	Oral (Viva Voce)	100
	Total Of A, B, C	400

Day 1	Day 2
Long exercise Bacteriology	Bacteriology Long exercise (Contd)
Bacteriology Short Exercise	Bacteriological Short Exercise (Contd)
Exercise in Parasitology	Mycology culture (Contd)
Exercise in Virology	Pedagogy
Mycology culture	Identification of Slides
Exercise in Serology	Grand Viva
<ul style="list-style-type: none"> • The above schedule can change as per the decision of the examiners 	

THESIS

Every candidate shall carry out work on an assigned research project under the guidance of a recognized Postgraduate Teacher, the result of which shall be written and submitted in the form of a Thesis. Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature.

Thesis shall be submitted at least six months before the theoretical and clinical / practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and practical examination. A post graduate student shall be allowed to appear for the final examination only after the acceptance of the thesis by the examiners.

Thesis should consist of

- (a) Introduction
- (b) Review of literature
- (c) Aims and objectives
- (d) Material and methods
- (e) Result
- (f) Discussion
- (g) Summary and conclusion
- (h) Tables
- (i) Annexure
- (j) Bibliography

ROTATIONAL POSTINGS:

A. Intrinsic rotation:

Bacteriology	6 Months
Serology	6 Months
Mycobacteriology and Molecular	4 Months
Mycology	4 Months
Virology/ HIV	4 Months
Parasitology	4 Months
Media Preparation	2 Months
Hospital Infection Surveillance	2 Months

B. Extrinsic rotation (Mandatory allied postings)

Clinical Pathology	1 Month
Clinical Biochemistry	1 Month
Skin and VD	1 Month
ICTC/ RNTCP	1 Month

Suggested Reading

Core Books

- Text Book of Microbiology (vol I & II) Mackie & MacCartney
- Diagnostic Microbiology Bailey & Scot
- Text Book of Microbiology Ananthanaryan
- Text Book of Parasitology CP Baveja KD Chatteraji
- Review of Medical Microbiology Jawetz

Reference Books

- Microbiology and Microbial Infection (Vol I- VI)- Topley & Wilson
- Colour Atlas & Text Book of Diagnostic Microbiology- Koneman
- Immunology- Ivan Roitt
- Text Book of Mycology -Emmons
- Medical Virology- Fenner

Journals

- Indian Journal of Medical Microbiology
- Indian Journal of Medical Research
- Clinical Microbiological Reviews
- Journal of Hospital Infection
- Lancet
- North American Clinics of Infectious Diseases
- Review of Infectious Diseases
- Tuberculosis
- Indian Journal of Tuberculosis

Annexure-40B of AC-41/2021

MGM INSTITUTE OF HEALTH SCIENCES, NAVI MUMBAI
MARKLIST FOR PRACTICAL AND VIVA-VOCE EXAMINATION

EXAMINATION CENTRE:

COURSE / EXAM : PG

DATE OF EXAMINATION :

EXAMINATION FOR : M.D. (MICROBIOLOGY)

Seat No.	A	B							PRACTICAL / CLINICAL TOTAL (1+2+3+4+5+6+ 7)	C	Grand Total A+B+C
	LONG EXERCISE	SHORT EXERCISES								ORAL	
		1	2	3	4	5	6	7		VIVA VOCE and Dissertation	
	BACTERIOLOGY	Bacteriology Pure Culture	Virology & Molecular	Mycology	Parasitology	Serology	Identification Of Slides	Microteaching / Pedagogy			
	60 Marks	40 Marks	40 Marks	40 Marks	40 Marks	40 Marks	30 Marks	10 Marks	300 Marks	100 Marks	400 Marks

NAME OF EXAMINER	COLLEGE	SIGNATURE WITH DATE
1		
2		
3		
4		

Resolution No. 4.13 of Academic Council (AC-49/2024): Resolved to approve the change in the syllabus of MD Microbiology adopted as per new NMC guidelines, to be applicable for batch admitted in academic year 2023-24 onwards [ANNEXURE-44A & 44C].

MGM Institute of Medical Sciences

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

COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN MICROBIOLOGY

Preamble

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

Currently the postgraduate students of Microbiology are trained in the laboratory with minimal exposure to patient care, but with technological advances and automation in diagnostic microbiology and increasing threat of infections due to emerging & reemerging microbes, drug resistance and widening host range, a microbiologist needs to develop clinical expertise in addition to technical expertise and be available more at the bedside to develop partnership with clinician in diagnosis and management of infectious disease cases. To fulfill these expectations, the program of MD Microbiology needs to shift focus to clinical aspects of microbiology, where a student is trained in the clinical setting and is able to contribute in the clinical management along with diagnosis, prevention and control of infectious disease.

This document provides guidelines to standardize Microbiology teaching at the postgraduate level throughout the country and fulfill the expectations as a microbiologist. The new curriculum guide has given more emphasis on training in patient care setting with integration of concepts of microbiology in various clinical specialties through dedicated postings, ward rounds, case discussion etc. This document has been prepared by subject-content specialists for the National Medical Commission. The Expert Group of the National Medical Commission had attempted to render uniformity without compromise to the purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

SUBJECT SPECIFIC OBJECTIVES (GOALS)

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

1. Demonstrate competence in clinical aspects as a Microbiologist to improve patient care.
2. Demonstrate application of microbiology in different clinical settings to address diagnostic and therapeutic problems along with preventive measures.
3. Play an important role in hospital infection control by actively participating in activities of the Hospital Infection Control Committee as a team member.
4. Demonstrate competence in recording, advising and guiding use of antimicrobials judiciously for infectious diseases in routine and in special clinical situations and population.
5. Demonstrate competence in developing guideline for antibiotic usage, including formulation of antibiotic policy in hospital.
6. Demonstrate communication skills required for safe & effective laboratory practice and teaching of microbiology
7. Demonstrate skills in conducting collaborative research in the field of Clinical Microbiology and allied sciences which has significant bearing on human health and patient care.
8. Demonstrate ability to plan, execute and evaluate teaching and training assignments efficiently and effectively in Microbiology for undergraduate students as per Competency Based Medical Education (CBME).
9. Identify public health epidemiology, global health patterns of infectious diseases and effectively participate in community outreach and public health programs for investigation, prevention and control of infectious diseases.
10. Demonstrate ability to work as a member of the rapid response team and contribute to investigations of outbreaks of infectious diseases in the hospital and outbreak/epidemic/pandemic in the community.
11. Demonstrate self-directed learning skills and keep updated with recent advances in the field of clinical microbiology.

12. Demonstrate administrative and organizational skills to establish good clinical microbiological services in a hospital and in the community in the field of clinical microbiology
13. Demonstrate effective leadership and teamwork skills while working with other members of the health care team in hospital, laboratory and community settings.
14. Demonstrate attributes of professional behavior and uphold the prestige of the discipline amongst the fraternity of doctors.

Postgraduate training

The postgraduate training should include the following components for a holistic approach-

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

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

1. Clinical Microbiology including Antimicrobial Resistance (AMR)

- i. Should be able to elicit relevant history for optimum clinico-microbiological correlation with laboratory results.
- ii. Should be able to perform basic physical examination and assess the patients with any suspected infection including community acquired/ tropical infection/ sepsis/ imported infection/ hospital acquired infections and emerging and re-emerging infections.
- iii. Should be able to formulate and critique diagnostic algorithms and patient care plans.

- iv. Should be able to choose, interpret and communicate the results of appropriate microbiological investigation in a suspected infection.
- v. Should be able to suggest optimal antimicrobial therapy, based on results of antimicrobial susceptibility tests and other investigations.
- vi. Should be able to advocate antibiotic stewardship for prevention and control of AMR (detailed competencies under AMR are given in Annexure I),
- vii. Should be able to educate patients/ relatives/ community on various aspects of antimicrobial use, antimicrobial drug resistance, prevention and control of infections.

2. Laboratory skills in diagnostic Microbiology

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

3. Infection Prevention and Control

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

4. Teaching and Learning Skills

- i. The Medical Education Department/Unit of the institution should be able to sensitize the postgraduate students in basic concepts of medical education technologies like domains of learning, teaching skills, teaching - learning methods, lesson planning, learning resource material, assessment techniques etc.

- ii. Should be able to demonstrate good teaching skills while conducting teaching/training sessions like tutorials, demonstrations and practical for undergraduate students, laboratory technicians etc. and participate actively in the planning and conduct of assessment of students learning at various stages of formative / summative assessment.
- iii. Should be able to learn by integrating with concerned subspecialty.

5. Research Skills

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

6. Communication and attitudinal skills

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

SUBJECT SPECIFIC COMPETENCIES

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

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

A) Predominant in Cognitive Domain (Knowledge):

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

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

General Microbiology (GM):

- i. Describe important historical events and developments in microbiology
- ii. Describe nomenclature, classification, morphology, growth requirements, pathogenesis and laboratory diagnosis of different bacteria, viruses, parasites and fungi.
- iii. Explain the importance of normal flora microbes, including Microbiome in health and disease.
- iv. Explain the factors influencing and significance of microbial environment in health care setup.
- v. Describe the epidemiology of common infectious diseases, host-parasite relationship and their significance.
- vi. Describe various types of microscopes and microscopic techniques used in diagnostic microbiology.
- vii. Explain various methods of isolation, identification and preservation of microbes in laboratory.
- viii. Explain the type, mechanism of action and applications of microbial toxins, other virulence factors & microbial products like Bacteriocins.
- ix. Explain the concept & application of various biosafety and biosecurity issues in laboratory and patient care including physical, biological containment and standard precautions.
- x. Discuss the various methods of sterilization and disinfection and apply them in the laboratory and in patient care.

- xi. Explain the basic principles of bacterial genetics and applications of molecular techniques in medical microbiology.
- xii. Explain the concept of microbiological surveillance including patient screening methods, organism typing and genome sequencing methodologies.
- xiii. Explain the concept and application of quality assurance, quality control and accreditation in diagnostic microbiology.
- xiv. Describe the significance and causes/reasons regarding emerging infectious diseases with strategies for their identification and control.
- xv. Explain the concept and application of molecular biology techniques in the laboratory diagnosis of infectious diseases.
- xvi. Explain the concept and use of information technology (LIS, WHO NET etc.) in microbiology laboratory effectively.
- xvii. Describe the principles & implementation of animal and human ethics involved in diagnostics and research in Microbiology
- xviii. Explain the principles and application of recent technological advances, automation, and application of Artificial Intelligence, nanotechnology, biosensors, bioinformatics, etc. in diagnosis & research in Microbiology.
- xix. Explain the importance and methods of testing microbiology of air, water and food in patient care both in community/ hospital setting.
- xx. Explain in detail about types & mechanism of action of Antimicrobial agents, their pharmacokinetics & pharmacodynamics, along with mechanism of drug resistance.
- xxi. Describe types and applications of Bacteriophages in diagnostic and therapeutic of infections

Immunology (IG)

- i. Describe the structure and function of the immune system, immunological mechanisms in health and response of the host immune system to infections. (Innate and acquired immunity, Cells involved in immune response, Antigens , Immunoglobulins, Mucosal immunity, Cell mediated immunity, Cytokines, MHC complex, Immune tolerance etc)
- ii. Explain the complement system and describe its role in health and disease.

- iii. Describe the mechanism/s in immunological disorders (hypersensitivity, autoimmune disorders and immunodeficiency states) and discuss the laboratory methods used in their diagnosis including measurement of immunological parameters
- iv. Describe the types & principles of antigen and antibody reactions and immunological techniques used in diagnostic microbiology as well as in research.
- v. Describe the immunological mechanisms of transplantation and tumor immunity.
- vi. Describe the mechanism/s and significance of immune-potentiation and immune-modulation.
- vii. Describe various types, techniques and advances in the development and applications of vaccines including UIP and immunotherapy and reverse vaccinology.
- viii. Explain the role of animals in immunology.

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

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

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

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

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

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

- **Opportunistic Infections** in special and high risk host
- **Infections in special situations/ scenario.**

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

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

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

Bacteria:

1. Gram positive cocci of medical importance including *Staphylococcus*, *Micrococcus*, *Streptococcus*, *anaerobic cocci* etc.
2. Gram negative cocci of medical importance including *Neisseria*, *Branhamella*, *Moraxella* etc.
3. Gram positive bacilli of medical importance including *Lactobacillus*, *Coryneform organisms*, *Bacillus* and *aerobic bacilli*, *Actinomyces*, *Nocardia*, *Actinobacillus* and other *actinomycetales*, *Erysipelothrix*, *Listeria*, *Clostridium* and other spore bearing anaerobic bacilli etc.
4. Gram negative bacilli of medical importance including *Enterobacteriaceae*, *Vibrios*, *Aeromonas*, *Plesiomonas*, *Haemophilus*, *Bordetella*, *Brucella*, *Gardnerella*, *Pseudomonas* and other *non-fermenters*, *Pasteurella*, *Francisella*, *Bacteroides*, *Fusobacterium*, *Leptotrichia* and other anaerobic gram negative bacilli etc.

5. *Helicobacter, Campylobacter, Calymmatobacterium, Streptobacillus, Spirillum* and miscellaneous bacteria
6. *Mycobacteria*
7. *Spirochaetes*
8. *Chlamydia*
9. *Mycoplasmatales; Mycoplasma, Ureaplasma, Acholeplasma and other Mycoplasmas.*
10. *Rickettsiae, Coxiella, Bartonella* etc.
11. Any newly emerging bacteria

Fungi:

1. Yeasts and yeast like fungi of medical importance including *Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces* etc.
2. Mycelial fungi of medical importance including *Dermatophytes, Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra, other dematiaceous hyphomycetes and other hyalohyphomycetes* etc.
3. Dimorphic fungi including *Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Talaromyces marneffeii* etc.
4. Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis Otomycosis, Phaeohyphomycosis etc
5. *Pythium insidiosum*
6. *Prototheca*
7. *Pneumocystis jirovecii*
8. *Lacazia loboi (Loboa loboi)*
9. Laboratory contaminant fungi
10. Fungi causing Mycetism and mycotoxicosis
11. Any newly emerging fungi

Virus:

1. DNA viruses of medical importance including Pox viruses, Herpes viruses, Adeno viruses, Hepadna virus, Papova and Parvo viruses etc.

2. RNA viruses of medical importance including Picorna viruses, Toga viruses, Flavi viruses, Orthomyxo viruses, Paramyxo viruses, Reo viruses, Rhabdo viruses, Arena viruses, Bunya viruses, Retro viruses, Filo viruses, Human immunodeficiency virus, Arbo viruses, Corona viruses, Calci viruses etc.
3. Oncogenic viruses
4. Bacteriophages
5. Slow viruses including prions
6. Unclassified viruses
7. Virioids
8. Any newly emerging virus

Parasite:

1. Protozoan parasites of medical importance including *Entamoeba*, *Free living amoebae*, *Giardia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Toxoplasma*, *Sarcocystis*, *Cryptosporidium*, *Cyclospora* *Isospora*, *Babesia*, *Balantidium*, etc.
2. Helminths of medical importance including those belonging to Cestoda (*Diphyllobothrium*, *Taenia*, *Echinococcus*, *Hymenolepis*, *Dipylidium*, *Multiceps* etc.), Trematoda (*Schistosomes*, *Fasciola*, *Fasciolopsis*, *Gastrodiscoides*, *Paragonimus*, *Clonorchis*, *Opisthorchis* etc.) and Nematoda (*Ascaris lumbricoides*, *Ancylostoma duodenale*, *Enterobius vermicularis*, *Trichuris trichiura*, *Filariasis* etc.)
3. *Rhinosporidium seeberi*
4. Entomology: common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myasis etc.
5. Neglected tropical parasitic diseases
6. Any newly emerging parasite

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

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

- i. **Prophylaxis** - Basic Principles and applications of general, immune as well as chemo- prophylaxis of infections in various clinical situations / scenarios.

- ii. **Vaccinology:** types of vaccines, principles, methods of preparation of vaccines and administration of vaccines.
- iii. **Health care associated Infections** - types, pathogenesis, diagnosis, prevention, control and surveillance of health care associated infections.
- iv. Biomedical waste and its management.
- v. **Role of microbes in non-communicable diseases** - infectious agents in origin and progression of non-communicable diseases like cancer, diabetes, musculoskeletal disorder and influence of these microbes on mental health.
- vi. **Antimicrobial Resistance Detection and Prevention:** classification, mechanism of action, detection and reporting drug resistance to antimicrobials (antibacterial, antiviral, antifungal, antimycobacterial and antiparasitic agents).
- vii. Investigation of an infectious disease outbreak in hospital and outbreak/epidemic/pandemic in community.
- viii. Information technology (computers) in microbiology.
- ix. Automation in Microbiology.
- x. Molecular techniques in the laboratory diagnosis of infectious diseases.
- xi. Statistical analysis of microbiological data and research methodology.
- xii. Animal and human ethics involved in microbiological work.
- xiii. Laboratory safety and management.

B. Predominant in Affective Domain

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

- v. Function as an effective team member and leader with good conflict management skills.
- vi. Adopt ethical principles, particularly maintenance of confidentiality when dealing with laboratory reports.
- vii. Demonstrate ability to recognize and manage ethical and professional conflicts and abide by prescribed ethical and legal codes of conduct and practice.
- viii. Demonstrate altruistic professional behavior with respect, discipline, responsibility, accountability, punctuality and integrity at all times while dealing with patients and their relatives.

C. Psychomotor Domain: (Skills)

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

➤ Laboratory skills:

- Collect, transport and store appropriate specimens for microbiological investigations.
- Receive and process clinical specimens after appropriate preparation of samples for the appropriate investigation (centrifugation, extraction, mincing concentration etc.)
- Processing of samples by various methods like:
 - Macroscopic/gross examination of samples.
 - Choose the most appropriate microscopic method for demonstration of pathogens.
 - Prepare, examine, and demonstrate microbes in direct smears for diagnosis of infectious disease/s.
 - Isolate and identify pathogenic microbe from clinical specimens (by conventional & automated methods).
 - Perform, interpret & record antimicrobial susceptibility testing of the isolate.
 - Perform rapid, conventional and automated serological techniques for diagnosis of infectious diseases and immunological diseases.
- Maintain records and ensure quality control in microbiology.

- Maintain and preserve microbial cultures.
- Operate and maintain instruments used in the laboratory for sterilization and disinfection and patient care with quality control.
- Operate and maintain common laboratory equipment like microscopes, water bath, centrifuge, incubator, automated culture system, micro-centrifuge, ELISA washer and reader etc.
- Perform and assess significance of microbial contamination of food, water and air.
- Biosafety measures - biosafety cabinets, chemical material safety data sheet (MSDS), fire safety, needle stick injury management.

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

- **Direct microscopic methods for demonstration of infectious agents:**
 - a. Wet mount examination for - looking for cells and organisms (bacteria, fungi, parasite)
 - i. Saline mount stool sample - parasitic morphology
 - ii. Iodine mount-parasitic morphology
 - iii. KOH for fungi
 - iv. Negative staining
 - b. Staining methods
 - i. Preparation of stains & quality check
 - ii. Preparation of peripheral blood smears from various samples
 - iii. Staining techniques - simple, differential, special staining methods - capsule, spore, flagella etc.
 - iv. Gram Staining
 - v. Acid Fast staining (with modifications).
 - vi. Leishman & Giemsa for demonstration of intracellular pathogen bacteria, parasite, fungi etc.
 - vii. Albert staining.
 - c. Fluorescent staining
 - i. Auramine staining - Mycobacterium tuberculosis.

- ii. QBC – for malaria.
 - iii. Calcoflor white staining for fungus
 - d. Isolation of pathogens
 - i. Preparation of glass wares
 - ii. Sterilization procedures
 - iii. Media preparation-required for isolation & identification
 - iv. Quality check of all media - functional as well as sterility check and maintenance of the record
 - v. Inoculation methods of various samples – surface, streak, stab etc depending on sample
 - vi. Incubation methods - aerobic, anaerobic, microaerophilic, capnophilic depending on the pathogens.
 - e. Identification of pathogen
 - i. Colony characters – various characters to be noted in different media.
 - ii. Staining to identify – Gram’s / Alberts / Acid Fast/ Lactophenol cotton blue depending on pathogen.
 - iii. Motility by hanging drop preparation and other methods.
 - iv. Biochemical reactions - phenotypic-enzymatic, oxidative fermentative, sugar fermentation, other special tests helping to identify up to species level.
 - v. Serotyping.
 - f. Antibiotic Susceptibility Testing
 - i. Selection of antibiotic disks as per CLSI/EUCAST based on the probable identification of organism - bacteria, fungi.
 - ii. Detection of drug resistant strains - MRSA, VISA, VRE, ESBL, MBL, CRE etc.
 - iii. Broth microdilution methods for bacteria and fungi.
- **Immunological tests**
 - i. i. Collection, preparation and storage of samples
 - ii. ii. Perform Rapid tests //Latex agglutination/ ICT/ELISA etc

- **Molecular tests**
 - i. PCR/RTPCR – all steps till interpretation
 - ii. CBNAAT
- **Biomedical waste management skills.**
- **Quality control skills in all areas.**

➤ **Clinical Microbiology Skills**

(Infectious Disease Case Based Skill)

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

➤ **Infection Prevention and Control Skills-**

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

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

- Demonstration of microbe by:

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

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

- Demonstration of microbes by Electron microscope
- Viral culture & identification of growth of viruses
- Immunological test
 - iii. Quantiferon
 - iv. Flowcytometry
- Molecular -
 - i. Genome Sequencing methods
 - ii. Molecular typing.

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

TEACHING AND LEARNING METHODS

General principles

Acquisition of competencies being the keystone of doctoral medical education, such training should be skills oriented. Learning in the program, essentially autonomous and self-directed, and

emanating from academic and clinical work, shall also include assisted learning. The formal sessions are meant to supplement this core effort.

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

Teaching-Learning methods

This should include a judicious mix of demonstrations, symposia, journal clubs, clinical meetings, seminars, small group discussion, bed-side teaching, case-based learning, simulation- based teaching, self-directed learning, integrated learning, interdepartmental meetings and any other collaborative activity with the allied departments. Methods with exposure to the applied aspects of the subject relevant to basic/clinical sciences should also be used. **The suggested examples of teaching-learning methods are given below but are not limited to these. The frequency of various below mentioned teaching-learning methods can vary based on the subject's requirements, competencies, work load and overall working schedule in the concerned subject.**

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

1. Subject related important topics as per specialty requirement
2. Recent advances
3. Research methodology and biostatistics
4. Salient features of Postgraduate medical curriculum
5. Teaching and assessment methodology.

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

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

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

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

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

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

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

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

Laboratory work/Clinics/bedside teaching should be coordinated and guided by faculty from the department. Various methods like DOAP (Demonstrate, Observe, Assist, Perform), simulations in skill lab, and case-based discussions etc. are to be used. Faculty from the department where a student is posted should participate in moderating the teaching-learning sessions during clinical rounds.

F. Interdepartmental colloquium

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

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

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

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

Clinical / Practical Training Schedule in Microbiology

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

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

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

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

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

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

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

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

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

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

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

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

setting, infection in different age groups, infections in special host like Immunocompromised host, traveler, specific occupations etc.

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

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

Emergency duty

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

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

All postgraduate students pursuing MD/MS in broad specialties in all Medical Colleges/Institutions shall undergo a compulsory rotation of three months in District Hospitals/District Health System as a part of the course curriculum, as per the Postgraduate Medical Education (Amendment) Regulations (2020). Such rotation shall take place in the 3rd or 4th or 5th semester of the Postgraduate programme and the rotation shall be termed as “District Residency Programme” and the PG medical student undergoing training shall be termed as “District Resident”.

Every posting should have its defined learning objectives. It is recommended that the departments draw up objectives and guidelines for every posting offered in conjunction with the collaborating department/s or unit/s. This will ensure that students acquire expected competencies and are not considered as an additional helping hand for the department / unit in which they are posted. The PG student must be tagged along with those of other relevant departments for bedside case discussion/basic science exercises as needed, under the guidance of an assigned faculty. }

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

H. Teaching research skills

Writing a thesis should be used for inculcating research knowledge and skills. All postgraduate students shall conduct a research project of sufficient depth to be presented to the University as a postgraduate thesis under the supervision of an eligible faculty member of the department as guide and one or more co-guides who may be from the same or other departments.

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

I. Training in teaching & learning skills

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

J. Log book

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

The purpose of the Log Book is to:

- a) Help maintain a record of the work done during training.

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

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

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

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

Other aspects

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

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

Skills & performance

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

ASSESSMENT

I. FORMATIVE ASSESSMENT, i.e., assessment to improve learning

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

General Principles

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

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

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

Quarterly assessment during the MD training should be based on:

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

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

- Attendance at Scientific meetings, CME programmes

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

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

Essential pre-requisites for appearing for examination include:

1. **Log book** of work done during the training period including rotation postings, departmental presentations, and internal assessment reports should be submitted.
2. At least **two presentations** at national level conference. One research paper should be published / accepted in an indexed journal. **(It is suggested that the local or University Review committee assess the work sent for publication).**

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

The postgraduate examination shall be in three parts:

1. Thesis

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

2. Theory examination

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

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

Paper I- General Microbiology and Immunology (GM & IG).

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

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

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

Universities shall prepare a blueprint for assessment of competencies and ensure 60-70% weightage is given to higher levels in Blooms taxonomy (application and above) in theory with more number of clinical scenario based questions. In **Paper II/III (CM – II/III) –distribution of Clinical Scenarios testing the ability of a student to deal with infections caused by**

various etiological agents is suggested to be 40-50% Bacterial, 20-30% Viral, 10-20 % each for Mycobacterial, Parasitic & Fungal pathogens.

3. Practical/Clinical and Oral/Viva Voce examination

Practical examination

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

Type of Exercises for Practical Examination should include cases (actual or paper based depending on the feasibility) of infectious diseases for workup and evaluation of clinical microbiology competence along with exercises to test ability to perform bacteriology, virology, parasitology, mycology, mycobacteriology, immunology, serology with microscopic examination and antimicrobial susceptibility report,.

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

Table 2. Suggested Day wise distribution of practical exercises:

Ex. No	Day -1	Ex. No	Day-2
1	Clinical Microbiology exercise (Give a real clinical case /paper based scenario addressing commonly seen cases in bacteriology/mycobacteriology/vir	1 cont	Clinical Microbiology exercise - Conclusion

	<p>ology/mycology/parasitology/HAI /AMR/out break /national project based etc of infectious diseases to the PG for workup and evaluation with respect to case history, basic physical examination, required investigations, interpretation of diagnostic test results, and therapeutic management decisions including prescription of antibiotics,, along with IC practices)</p>		
2	<p>Long Exercise- Bacteriology (Mixed culture given with a clinical history representing any specimen collected from respective systemic infection)</p>	2 cont	<p>Long Exercise - Bacteriology conclusion</p>
3	<p>Short Exercise – Bacteriology (Identification of a pure culture)</p>	3 cont	<p>Short Exercise - Bacteriology conclusion</p>
4	<p>Serology Exercise (In a clinical case, choice of test & technique with interpretation of test results)</p>	4 cont	<p>Serology cont. if required</p>
5	<p>Virology techniques (In a clinical case, choice of test & technique with interpretation of test results. Viral serology/ Molecular</p>	5 cont	<p>Virology cont. if required</p>

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

13. Topley and Wilson's Microbiology and Microbial infection by Brian W. J. Mahy, Graham Selby Wilson, and William Whiteman Carlton Topley
14. Text book of Medical Mycology by Jagadish Chandra
15. Atlas of Fungal infection by Carol A. Kauffman
16. Bennett and Brachman's Hospital Infection, 6th edition, William R Jarvis.

Journals

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

Annexure I

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

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

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

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

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

Subject Expert Group members for preparation of REVISED Guidelines for competency based postgraduate training programme for MD in Microbiology

1. **Dr Suman Singh** **Convener, Subject Expert Group**
Professor, Department of Microbiology
Pramukhswami Medical College,
Bhaikaka University.
Karamsad,388325

2. **Dr Purnima Barua** Member
Associate Professor of Microbiology
Medical Superintendent
Jorhat Medical College & hospital
Jorhat, Assam

3. **Dr Nidhi Singla** Member
Professor of Microbiology
Government Medical College Hospital
Sector 32 B,
Chandigarh 160030

4. **Dr. S Muralidharan** Member
Professor of Microbiology,
St. John's Medical College,
Bangalore.

5. **Dr B Anuradha** Member
Professor & Head
Department of Microbiology
Mamata Medical College,
Khammam, Telangana

6. **Dr. K. Anuradha** Member
Professor & Head,
Department of Microbiology
Mysore Medical College & Research Institute
Mysore

ANNEXURE 4

**MD Microbiology Assessment Pattern
MGM Medical College and Hospital
(Kamothe, Aurangabad)**

University Exam:

THEORY

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

Paper I- General Microbiology and Immunology (GM & IG).

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

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

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

<p>Theory (four papers) -100 marks each paper</p> <p>10/11 Brief Answer questions (10 marks each)</p>	<p>Paper I :General Microbiology, Immunology</p> <p>Paper II: Systemic / Clinical Microbiology 1</p> <p>PaperIII : Systemic / Clinical Microbiology 2</p> <p>Paper IV: Applied Microbiology& Recent advances</p> <p>Total : 400 marks</p>
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PRACTICAL

1. Practical/Clinical and Oral/Viva Voce examination

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

Type of Exercises for Practical Examination should include cases (actual or paper based depending on the feasibility) of infectious diseases for workup and evaluation of clinical microbiology competence along with exercises to test ability to perform bacteriology, virology, parasitology, mycology, mycobacteriology, immunology, serology with microscopic examination and antimicrobial susceptibility report.

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

Table 2. Suggested Day wise distribution of practical exercises:

Ex No	Day -1	Ex. No	Day-2
1	<p>Clinical Microbiology exercise (Give a real clinical case /paper based scenario addressing commonly seen cases in Bacteriology /mycobacteriology / virology / mycology / parasitology / HAI /AMR/out break /national project based etc of infectious diseases to the PG for workup and evaluation with respect to case history, basic physical examination, required investigations, interpretation ofdiagnostic test results, and therapeutic management decisions including prescription ofantibiotics, along with IC practices)</p>	1 cont	<p>Clinical Microbiology exercise –Conclusion</p>

2	Long Exercise- Bacteriology (Mixed culture given with a clinical history representing anyspecimen collected from respective systemic infection)	2 cont	Long Exercise - Bacteriology conclusion
3	Short Exercise – Bacteriology (Identification of a pure culture)	3 cont	Short Exercise - Bacteriology conclusion
4	Serology Exercise (In a clinical case, choice of test & technique with interpretation of test results)	4 cont	Serology cont. if required
5	Virology techniques (In a clinical case, choice of test & technique with interpretation of test results. Viral serology / Molecular techniques depending upon availability)	5 cont	Virology cont. if required
6	Mycology (Identification of fungi in a clinical case)	6 cont	Mycology cont. if required
7	Parasitology (In a clinical case, choice of test & technique with interpretation of test results Stool examination, Examination)	9	Pedagogy (10-15minutes)

	of Peripheral blood smear etc)		
8	Slides (Slides including histopathology for microscopic identification & discussion	10	Log book, Dissertation Viva, Grand-Viva

University Practical Marks:

<ul style="list-style-type: none"> • Clinical Microbiology exercise- 20 Marks • Bacteriology Long Case- 60 Marks • Bacteriology Short Case- 40 Marks • Virology exercise- 40 Marks • Parasitology Exercise -30 Marks • Mycology Exercise- 30 Marks • Serology Exercise- 40 marks • Pedagogy -10 Marks • Identification of Slides- 10 Marks • Dessertation/ Thesis- 20 Marks • Grand viva - 100 Marks <p>Total : 400 marks</p>

Internal Exam Pattern:

Internal exam will be held every year for all PG students as per their academic calendar

1st year Exam

Theory (one paper) of 100 marks	General Microbiology and Immunology BAQs :10/11 questions (10 Marks each) Total : 100 marks
Practical 100 marks	Gram stain: 15 marks ZN stain : 15 marks Serology : 20 marks Grand viva : 50 marks Total : 100 marks
2nd year exam	
Theory (two papers) 100 marks each	I Systemic/ Clinical microbiology 1 II Systemic and Clinical Microbiology 2 BAQs :10/11 questions (10Marks each) Total : 200 marks
Practical	Bacteriology long exercise : 50 marks Bacteriology short exercise : 20 marks Mycobacteriology: 10 Marks Parasitology 10 Marks Serology : 20 marks Fungal culture : 20 marks Virology exercise : 20 Marks Grand viva : 50 marks

	Total : 200 Marks
Prelim exam (3rd year exam)	
Theory (four papers) 100 marks each (Same as University Exam)	<p>I General Microbiology, Immunology II Systemic / Clinical Microbiology 1 III Systemic and Clinical Microbiology 2 IV Applied Microbiology& Recent advances</p> <p>BAQs- 10/11 (10 Marks each)</p> <p>Total : 400 marks</p>
Practical (Same as University exam)	<ul style="list-style-type: none"> • Clinical Microbiology exercise- 20 Marks • Bacteriology Long Case- 60 Marks • Bacteriology Short Case- 40 Marks • Virology exercise- 40 Marks • Parasitology Exercise -30 Marks • Mycology Exercise- 30 Marks • Serology Exercise- 40 marks • Pedagogy -10 Marks • Identification of Slides- 10 Marks • Dissertation- 20 Marks • Grand viva - 100 Marks <p>Total : 400 marks</p>



MGM INSTITUTE OF HEALTH SCIENCES

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

Grade 'A' Accredited by NAAC

Sector-01, Kamothe, Navi Mumbai - 410209

Tel 022-27432471, 022-27432994, Fax 022-27431094

E-mail- registrar@mgsuhs.com Website : www.mgsuhs.com

