TEERTHANKER MAHAVEER MEDICAL COLLEGE & RESEARCH CENTER

TEERTHANKER MAHAVEER UNIVERSITY

CBME CURRICULUM

MD (MICROBIOLOGY)

Accredited with NAAC A Grade

12-B Status from UGC

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National Medical Commission
Postgraduate Medical Education Board (Academic Cell)

D 11011/1/221AC Date: 20-06-2022

ADVISORY

Subject: Guidelines for competency based postgraduate training programme for broad specialty and super-specialty subjects.

The National Medical Commission, through Subject Expert Groups, has prepared GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME for various broad and superspecialty subjects. These Guidelines have been scrutinized by the Reconciliation Board cum Expert Group of NMC and are uploaded on NMC Website. These guidelines will be mandatory teaching-learning material for all institutions/colleges under NMC.

(Dr. Vijay Oza) President,

PG MEB

GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN MICROBIOLOGY

Preamble:

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

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

SUBJECT SPECIFIC OBJECTIVES

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

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

Post-graduate training

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

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

a. Laboratory and Diagnostic skills in Clinical Microbiology:

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

b. Teaching Skills

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

c. Research Methodology

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

d. Communication and attitudinal skills

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

SUBJECT SPECIFIC COMPETENCIES

A) Cognitive Domain:

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

General Microbiology

1. Important historical events and developments in microbiology
2. Basic as well as advanced knowledge in various microscopes and microscopic techniques used in diagnostic microbiology

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

Immunology

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

Systemic bacteriology

1. Demonstrate knowledge and skills in various techniques for isolation and identification of bacteria
2. Demonstrate knowledge about epidemiology, morphology, biochemical properties, antigenic nature, pathogenesis, complications, laboratory diagnosis treatment and prevention of major bacterial pathogens of medical importance given below-
    a. Gram positive cocci including *Staphylococcus*, *Micrococcus*, *Streptococcus*, anaerobic cocci etc.

b. Gram negative cocci including *Neisseria, Branhamella, Moraxella* etc.

c. Gram positive bacilli including *Lactobacillus, Coryneform* bacteria, *Bacillus* and aerobic bacilli, *Actinomyces, Nocardia, Actinobacillus and other actinomycetales, Erysipelothrix, Listeria, Clostridium* and other spore bearing anaerobic bacilli etc.

d. Gram negative bacilli including *Vibrios, Aeromonas, Plesiomonas, Haemophilus, Bordetella, Brucella, Gardnerella, Pseudomonas* and other non-fermenters, *Pasteurella, Francisella, Bacteroides, Fusobacterium, Leptotrichia* and other anaerobic gram negative bacilli etc.

e. *Helicobacter, Campylobacter, Calymmatobacterium, Streptobacillus, Spirillum* and miscellaneous bacteria

f. *Enterobacteriaceae*

g. *Mycobacteria*

h. *Spirochaetes*

i. *Chlamydia*

j. *Mycoplasmatales: Mycoplasma, Ureaplasma, Acholeplasma* and other *Mycoplasmas.*

k. *Rickettsiae, Coxiella, Bartonella* etc.

Mycology

1. Explain general characteristics including morphology, reproduction and classification of fungi
2. Demonstrate knowledge and skills for isolation and identification of fungi
3. Explain tissue reactions to fungi
4. Demonstrate knowledge about epidemiology, morphology, biochemical properties, antigenic nature, pathogenesis, complications, laboratory diagnosis treatment and prevention of major fungal pathogens of medical importance given below-

    a. Yeasts and yeast like fungi including *Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces* etc.

    b. Mycelial fungi including *Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra,* other dematiaceous hyphomycetes and other hyalohyphomycetes etc.

    c. Dimorphic fungi including *Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffei* etc.

    d. Dermatophytes

    e. Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis and Otomycosis.

    f. *Pneumocystis jirovecii* infection

    g. *Rhinosporidium seeberi* and *Lacazia loboi* (formerly named *Loboa loboi)*

    h. *Pythium insidiosum*

    i. *Prototheca*

5. Able to identify laboratory contaminant fungi
6. Explain Mycetism and mycotoxicosis along with agents involved

7. Demonstrates knowledge about antifungal agents and perform *in vitro* Antifungal susceptibility tests.

Virology

1. Demonstrates knowledge about general properties, classification, morphology, virus replication and genetics of viruses
2. Explain pathogenesis of viral infections
3. Demonstrates knowledge about isolation and identification of viruses
4. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of major DNA viruses of medical importance including *Pox viruses, Herpes viruses, Adeno viruses, Hepadna virus, Papova viruses* and *Parvo viruses* etc.
5. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of major RNA viruses of medical importance including *Entero 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.
6. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of major *Hepatitis viruses*
7. Demonstrate knowledge about epidemiology, morphology, genetics, antigenic nature, pathogenesis, complications, laboratory diagnosis, treatment and prevention of unclassified viruses and slow viruses including prions
8. Demonstrate knowledge about viral vaccines and anti-viral drugs.

Parasitology

1. Demonstrate knowledge about general characters, classification and methods of identification of parasites.
2. Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of Protozoan parasites of medical importance including *Entamoeba, Free living amoebae, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma, Sarcocystis, Cryptosporidium, Microsporidium, Cyclospora Isospora, Babesia, Balantidium*, etc.
3. Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of helminthes of medical importance including those belonging to Cestoda (*Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipyllidium, Multiceps* etc.), Trematoda (*Schistosomes, Fasciola, Fasciolopsis, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis* etc.) and Nematoda (*Trichiuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus* etc.)

4. Demonstrate knowledge about common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myasis of medical importance.
5. Demonstrate knowledge about anti-parasitic vaccine and drugs.

Applied Microbiology

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

B) Affective Domain:

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

C) Psychomotor domain:

1. Collection/transportation of specimens for microbiological investigations
2. Preparation, examination and interpretation of direct smears from clinical specimens
3. Pluting of clinical specimens on media for isolation, purification, identification and quantification purposes.

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

- **Time frame to acquire knowledge & skills:**
  - **Knowledge :**

End of 1st year	End of 2nd year	End of 3rd year
GENERAL MICROBIOLOGY: 1. History and Pioneers in Microbiology 2. Microscopy 3. Nomenclature and classification of microbes 4. Morphology of bacteria and other micro-organisms 5. Growth and Nutrition of bacteria 6. Bacterial metabolism 7. Sterilization anddisinfection 8. Culture mediaand culture methods 9. Identification ofbacteria 10. Bacterial toxins 11. Bacterial antagonism : Bacteriocins 12. Bacterial genetics 13. Gene cloning 14. Antibacterial substances used in the treatment of infections and drug resistance inbacteria 15. Bacterial ecology - Normal flora of human body, Hospital environment, Air, Water and Milk 16. Host-parasite relationship	**IMMUNOLOGY :Clinical** 1. Hypersensitivity 2. Immunodeficiency 3. Auto-immunity 4. Immune tolerance 5. Transplantation immunity 6. Tumour immunity 7. Immunoprophylaxi sand immunotherapy 8. Measurement of immunity	**GENERAL MICROBIOLOGY & IMMUNOLOGY:** **All**
IMMUNOLOGY : 1. Innate andacquired immunity 2. Antigens 3. Immunoglobulins 4. Antigen andantibody Reactions 5. ComplementSystem 6. The normal immune system: structure and function 7. Immune Response	**SYSTEMATIC BACTERIOLOGY** 1. *Streptococcus and Lactobacillus* 2. *Staphylococcus and Micrococcus* 3. *Pseudomonas* 4. *The Enterobacteriaceae* 5. *Mycobacteria* 6. *Corynebacterium* and otherCoryneform bacteria 7. *Vibrios, Aeromonas, Plesiomonas, Campylobacter &Spirillum* 8. *Neisseria, Branhamella &Moraxella* 9. *Haemophilus and Bordetella* 10. *Bacillus:* the aerobic spore-bearing bacilli 11. *Clostridium:* the spore-bearinganaerobic bacilli 12. Non-sporing anaerobe 13. The *Spirochaetes*	**SYSTEMATIC BACTERIOLOGY (2nd year) : plus** 1. *Actinomycetes,Nocardia and Actinobacillus* 2. *Erysipelothrix andListeria* 3. The *Bacteroidaceae: Bacteroides, Fusobacterium and Leptotrichia* 4. *Chromobacterium, flavobacterium, Acinetobacter and Alkaligenes* 5. *Pasteurella, Francisella* 6. *Brucella* 7. *Chlamydia* 8. *Rickettsiae* 9. *Mycoplasmatales: Mycoplasma, Ureaplasma and Acholeplasma* 10. Miscellaneousbacteria

MICROBIOLOGY APPLIED TOTROPICAL MEDICINE ANDRECENT ADVANCES 1. Normal Microbialflora 2. Epidemiology ofinfectious diseases 3. Hospital acquiredinfections & Hospital waste disposal 4. Bacteriology ofwater milk and air	**VIROLOGY:** 1. The nature of viruses 2. Classification of viruses 3. Morphology: virus structure 4. Virus replication 5. The genetics of viruses 6. The pathogenicity & labdiagnosis of viruses 7. Epidemiology of viral infections 8. Anti-viral drugs 9. Bacteriophages *10. Herpes viruses* *11. Paramyxoviruses* *12. Influenza virus* *13. Hepatitis viruses* *14. Rabies virus* *15. Human immunodeficiencyviruses*	**VIROLOGY (2nd year): plus** 1. Vaccines *2. Pox viruses* *3. Vesicular viruses* *4. Toga viruses* *5. Bunya viruses* *6. Arena viruses* *7. Marburg andEbola viruses* *8. Rubella virus* *9. Orbi viruses* *10.* Respiratory diseases : *Rhinoviruses, adenoviruses* and*corona viruses* *11.* Enteroviruses; *Polio, Echo, and Coxsackie viruses* 12. Other entericviruses 13. Slow viruses 14. Oncogenic viruses 15. Teratogenicviruses
	PARASITOLOGY: **1.** General Parasitology **2. Protozoan parasites of medicalimportance:** *Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma ,Plasmodium*	**PARASITOLOGY (2nd year): plus** **1. Protozoan parasites of medical importance:** *Toxoplasma, Sarcocystis, Cryptosporidium,Babesia, Balantidium* etc. **2. Helminthology:** All those medicallyimportant helminthes belonging to Cestoda, Trematoda and Nematoda. *3.* **Cestodes:** *Diphyllobothrium,Taenia, Echinococcus, Hymenolepis, Dipyllidium, Multiceps* etc. **4. Trematodes:** *Schistosomes, Fasciola, Gastrodiscoides, Paragonimus, Clonorchix, Opisthorchis* etc. **5. Nematodes:** *Trichuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris,Toxocara, Enterobius, Filarial worms, Dracunculus,* etc. **6. Ecto-parasites:** Common arthropods and other vectors viz.,Mosquito, Sand fly, Ticks, Mite, Cyclops

	MYCOLOGY 1. The morphology andreproduction in fungi 2. Classification of fungi 3. *Dermatophytes* 4. *Candida* 5. *Aspergillus*	**MYCOLOGY (2nd year): plus** 1. Contaminant and opportunistic fungi 2. Fungi causing superficial mycoses 3. Fungi causing subcutaneousmycoses 4. Fungi causing systemic infections 5. Anti-mycoticagents
		MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES 1. Infections of various organs andsystems of human body 2. Molecular genetics as applicable to microbiology 3. Vaccinology: principle, methodsof preparation, administration of vaccines. 4. Bio-terrorism

	ALLIED BASICSCIENCES	**(a) Biochemistry:** Basic understanding of biochemistry as applied to immunological/ molecular methods for studyof microbial diseases and pathogenesis of infections. **1.** Protein purification andestimation **2.** Protein estimation **3.** Nucleic acid purification and characterization **4.** Agarose and polyacrylamide gel electrophoresis - principles **5.** Ultracentrifugation – principles **6.** Column chromatography –principles **(b) Molecular biology:** Basic knowledge as applicable to molecular diagnostics andmolecular epidemiology. 1. Recombinant DNAtechnology 2. Southern, northernand western blotting 3. DNA amplificationtechniques 4. Diagnostic PCR, different methodsof PCR product detection (liquid hybridization, ELISA). 5. Genotyping ofmicrobes and viruses **(c) Pathology: (as applied to Microbiology)** Basic knowledgeof 1. Inflammation andrepair 2. Intercellular substances and reaction 3. Pathological changes in the body in bacterial, viral, mycotic and parasitic infections Demonstration ofpathogen in tissuesection

- **Skills:**

1st 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 *M. leprae*	5	5	5
	5	Modified ZN staining for *Nocardia*	5	5	5
	6	IQC-staining	5	5	5
Media preparation	1	Preparation of stains	4	4	4
	2	Preparation of reagents	10	10	10
	3	Preparation, plugging, pouring	20	20	30
		& Quality Control (QC) of culture media			
	4	Operation & maintenance of autoclave	10	10	20
Bacteriology	1	Specimen collection for Blood Culture	5	5	5
	2	Inoculation of liquid & solid media	20	20	30
	3	Identification test	20	20	30

	4	Antimicrobial sensitivity testing- modified Kirby-bauer technique	10	20	30
	5	IQC- Antibiotic disc potency	5	5	-
	6	Operation of BacT/ALERT	5	10	20
	7	Operation of Vitek 2 compact	5	10	20
	8	Petroff's concentration technique	10	10	20
	9	AFB culture & sensitivity	5	10	20
Mycology	1	KOH Wet mount	5	10	20
	2	Germ tube test	5	10	20
	3	Slide culture	5	10	20
	4	Negative staining for fungus	5	5	5
	5	LPCB mount	10	10	10
Parasitology	1	Giemsa staining for thick & thin peripheral blood smear	5	-	-
	2	Stool wet mount for R/M	10	20	30
	3	Stool concentration techniques	5	10	5
	4	Modified ZN staining for *C. parvum*	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

2nd 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 *M. leprae*	--	--	5
	5	Modified ZN staining for *Nocardia*	--	--	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 *C. parvum*	--	--	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 independentl yno. (under supervisio n)
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 *M. leprae*	--	--	5
	5	Modified ZN staining for *Nocardia*	--	--	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 *C. parvum*	--	--	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

Syllabus

Course contents:

Paper I: General Microbiology

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

Immunology

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

18. Vaccines and immunotherapy
19. Measurement of immunological parameters
20. Immunological techniques
21. Immunopotentiation 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, Chromoblatomycosis, Occulomycosis and Otomycosis.
10. *Pythium insidiosum*

11. *Prototheca*
12. *Pneumocystis jirovecii infection*
13. *Rhinosporidium seeberi and Lacazia loboi (Loboa loboi)*
14. Laboratory contaminant fungi
15. Mycetism and mycotoxicosis
16. Antifungal agents and *in vitro* antifungal susceptibility tests.

Paper III: Virology

1. General properties of viruses
2. Classification of viruses
3. Morphology: Virus structure
4. Virus replication
5. Isolation and identification of viruses
6. Pathogenesis of viral infections
7. Genetics of viruses
8. DNA viruses of medical importance including Pox viruses, Herpes viruses, Adeno viruses, Hepadna virus, Papova and Parvo viruses etc.
9. RNA viruses of medical importance including Enteroviruses, Toga viruses, Flavi viruses, Orthomyxo viruses, Paramyxo viruses, Reo viruses, Rhabdo viruses, Arena viruses, Bunya viruses, Retro viruses, Filo viruses, Human immunodeficiency virus, Arbo viruses, Corona viruses, Calci viruses etc.
10. Slow viruses including prions
11. Unclassified viruses
12. Hepatitis viruses
13. Viriods, prions
14. Vaccines and anti-viral drugs.

Parasitology

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

Paper IV: Applied Microbiology

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

TEACHING AND LEARNING METHODS

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

Post Graduate Training programme

Teaching methodology

Based on the available facilities, the Department can prepare a list of post graduate experiments pertaining to basic and applied microbiology. Active learning should form the mainstay of post graduate training; there should be lectures for post graduates (at least20 per year), along with seminars, symposia, group-discussions and Journal clubs. The post graduate students should regularly do the ward rounds of various clinical departments and learn cases of interest for discussion with the clinical faculty. Each college should have a Medical Education Unit to generate teaching resource material for undergraduates and evolving of problem solving modules.

Rotation:

Postings to laboratories/assignments

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

Suggested schedule of rotation:

Within Department

1. Bacteriology
2. Mycobacteriology
3. Serology/Immunology
4. Mycology
5. Virology
6. Parasitology
7. Media preparation

Other Departments

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

Practical training

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

Skills & performance

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

Emergency duty

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

Training in research methodology

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

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

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

Communication and attitudinal skills

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

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

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

- Department should encourage e-learning activities.

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

ASSESSMENT

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

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

General Principles

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

Quarterly assessment during the MD programme should be based on:

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

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

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

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

The post-graduate examinations should be in three parts:

1. **Thesis.**

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

Thesis shall be submitted at least six months before the Theory and Clinical / Practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and

Clinical examination. A post graduate student shall be allowed to appear for the Theory and Practical/Clinical examination only after the acceptance of the Thesis by the examiners.

2. Theory Examination

The examinations shall be organized on the basis of 'Grading' or 'Marking system' to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training. Obtaining a minimum of 50% marks in 'Theory' as well as 'Practical' separately shall be mandatory for passing examination as a whole. The examination for M.D./ MS shall be held at the end of 3rd academic year. An academic term shall mean six month's training period.

There should be four theory papers each of 100 marks: (Total 400 marks)

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

3. Practical and Oral/viva voce Examination: (400 Marks)

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

- **Bacteriology: (130 Marks)**

1. Identification of a pure culture. (50 marks)
2. Isolation and Identification of Bacteria from Clinical Samples (80 Marks)

- **Serology: (30 Marks)**

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

- **Virology: (30 Marks)**
  1. Preparation of tissue cultures
  2. Virus Titration
  3. Haemagglutination and its inhibition test
  4. Virus Neutralization Test
  5. Other rapid tests for diagnosis of viral infections
- **Mycology (40 Marks)**
  1. Identification of fungal cultures
  2. Slide culture techniques
  3. Examination of histopathology slides for fungi
- **Parasitology (30 marks)**
  1. Processing and Identification of ova and cysts in stool samples
  2. Amoebic Serology
  3. Microscopic Slides
  4. Examination of histopathology slides for parasites

Spotting: 10 spots (40 Marks)

Oral/Viva-Voce Examination: (100 Marks)
This must include a component of teaching session of not more than 15 minutes duration.

Recommended Reading:

Books (Latest edition)

1. Forbes B, Sahm D, Weissfeld A. *Bailey and Scott's Diagnostic Microbiology*. Mosby, St. Louis.
2. Koneman EW, Allen SD, Janda WM, Schreckenberger PC, Winn WC. *Color Atlas and Textbook of Diagnostic Microbiology*. J.B. Lippincott, Philadelphia.
3. Murray PR, Baron EJ, Pfaller MA, Tenover FC, Yolken RH. *Manual of Clinical Microbiology*. American Society for Microbiology.
4. Garcia LS, Bruckner DA. *Diagnostic Medical Parasitology*. American Society for Microbiology.
5. Wiedbrauk DL, Johnston SLG. *Manual of Clinical Virology*. New York, Raven Press.
6. Bailey and Scott's Diagnostic Microbiology.

Journals

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

Annexure 1

Postgraduate Students Appraisal Form Pre/Para/Clinical Disciplines

Name of the Department/Unit :

Name of the PG Student :

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

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

Publications Yes/ No

Remarks* _____

_____

_____

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

SIGNATURE OF ASSESSEE SIGNATURE OF CONSULTANT SIGNATURE OF HOD

MODEL QUESTION PAPER

MD (Microbiology) Paper-I
General Microbiology & Immunology

Max. Marks:100 *Time: 3 hrs*

- ***Attempt ALL questions***
- ***Answer each question & its parts in SEQUENTIAL ORDER***
- ***ALL questions carry equal marks***
- ***Illustrate your answer with SUITABLE DIAGRAMS***

I Discuss genetic basis of drug resistance in bacteria.

II Enlist important primary immunodeficiency diseases. Describe DiGeorge's syndrome.

III What are histocompatibility antigens? Discuss HLA typing.

IV What is microarray? Describe its principle and applications in microbiology. V Explain hybridoma technology and give its applications in microbiology.

VI What is redox potential? Describe giving suitable examples.

VII Enumerate various tests used for determining the efficacy of disinfectants. Discuss briefly the phenol-coefficient test.

VIII Enumerate various tests used for determining the efficacy of disinfectants. Discuss briefly the phenol-coefficient test.

IX Differentiate between classical and alternate pathways of complement activation. Discuss the role of complement in various serological tests.

X Categorize pathogens according to hazard and categories of containment. Discuss various types of microbiological biosafety cabinets.

MODEL QUESTION PAPER

MD (Microbiology) Paper-II
Bacteriology and Mycology

Max. Marks:100 *Time: 3 hrs*

- ***Attempt ALL questions***
- ***Answer each question & its parts in SEQUENTIAL ORDER***
- ***ALL questions carry equal marks***
- ***Illustrate your answer with SUITABLE DIAGRAMS***

I Discuss the laboratory diagnosis of antibiotic associated diarrhea.

II Discuss etiology, pathogenesis and laboratory diagnosis of Weil's disease. III What are PBP's ? Discuss their role in drug resistance.

IV Discuss briefly GISA.

V Explain the mechanism of action and methods of detection of enterotoxin

VI Discuss etiology, pathogenesis and laboratory diagnosis of Cat Scratch Disease.

VII Enumerate various dematiaceous fungi and discuss their pathogenicity. VIII What are mycotoxins ? Discuss mycotoxicosis.

IX Classify antifungal agents. Discuss the methods of anti-fungal susceptibility testing.

X Define conidiogenesis and explain with suitable diagrams.

MODEL QUESTION PAPER

MD (Microbiology)
Paper-III
Virology & Parasitology

Max. Marks:100 *Time: 3 hrs*

- ***Attempt ALL questions***
- ***Answer each question & its parts in SEQUENTIAL ORDER***
- ***ALL questions carry equal marks***
- ***Illustrate your answer with SUITABLE DIAGRAMS***

I Name various nonpathogenic ameobae. Discuss the life cycle, pathogenicity and laboratory diagnosis of any one of them.

II Discuss rapid diagnostic tests in parasitology along with their clinical applications.

III Enlist and discuss laboratory diagnosis of opportunistic parasitic infections in immunocompromised patients.

IV Discuss the etiology, pathogenesis and diagnosis of Tropical Pulmonary Eosinophilia.

V Classify oncogenic viruses and explain the various mechanisms of viral oncogenesis.

VI What are Interferons ? Explain their mechanism and clinical applications.

VII Discuss etiology, pathogenesis and laboratory diagnosis of viral hemorrhagic fever.

VIII Define Prions. Classify Prion diseases and discuss their pathogenesis and diagnosis.

IX Enumerate various congenital viral infections and discuss their laboratory diagnosis.

X Write briefly on transfusion transmitted hepatitis.

MODEL QUESTION PAPER

MD (Microbiology) Paper-IV

Applied Microbiology and Recent Advances in Microbiology

Max. Marks:100 *Time: 3 hrs*

- ***Attempt ALL questions***
- ***Answer each question & its parts in SEQUENTIAL ORDER***
- ***ALL questions carry equal marks***
- ***Illustrate your answer with SUITABLE DIAGRAMS***

I What are the edible vaccines? Discuss the current status and future of edible vaccines.

II What is flowcytometery? Give its principle and uses in clinical microbiology.

III Define transgenic mice and discuss its role in study of microbial pathogenicity.

IV What is the role of microbiologist in Hospital Infection Control Committee?

V What is quality control ? Describe various methods adopted for internal quality control in microbiology.

VI Discuss the emerging and reemerging bacterial infections.

VII What are biofilms. Describe their significance in clinical microbiology.

VIII Discuss PEP in case of needle stick injury.

IX Define and categorize biomedical waste. Discuss its management.

X Discuss various methods used for bacteriological examination of water.