

**KRISHNA INSTITUTE OF MEDICAL SCIENCES, KARAD**

**DEPARTMENT OF MICROBIOLOGY**

**PG (MD) Code -1204**

**MICROBIOLOGY Code – 1204-11 to 1204 - 14**

**Preamble:**

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

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

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

**COURSE OBJECTIVES:**

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

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

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

### **Post-graduate training**

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

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

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

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

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

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

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

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

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

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

### **SUBJECT SPECIFIC COMPETENCIES**

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

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

##### **General Microbiology**

1. Important historical events and developments in microbiology
2. Basic as well as advanced knowledge in various microscopes and microscopic techniques used in diagnostic microbiology
3. Various bio-safety issues including physical and biological containment, universal containment, personal protective equipment for biological agents
4. Various isolation precautions including standard and transmission based precautions
5. In-depth knowledge about various methods 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 of drug resistance
13. Bacterial genetics, bacteriophages and molecular genetics relevant for medical microbiology
14. Applications of quality assurance, quality control in microbiology and accreditation of laboratories

## Immunology

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

## Systemic bacteriology

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

- h. *Spirochaetes*
- i. *Chlamydia*
- j. *Mycoplasmatales; Mycoplasma, Ureaplasma, Acholeplasma* and other *Mycoplasmas*.
- k. *Rickettsiae, Coxiella, Bartonella* etc.

## **Mycology**

1. Explain general characteristics including morphology, reproduction and classification of fungi
2. Demonstrate knowledge and skills for isolation and identification of fungi
3. Explain tissue reactions of 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, and 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, Chromoblastomycosis, Occulomycosis and Otomycosis.
  - f. *Pneumocystis jirovecii* infection
  - g. *Rhinosporidium seeberi* and *Lacazia loboi* (formerly named *Loboaloboi*)
  - 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 *Poxviruses*, *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*, *Sporospora*, *Babesia*, *Balantidium*, etc.
3. Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of helminthes of medical importance including those belonging to Cestoda (*Diphyllobothrium*, *Taenia*, *Echinococcus*, *Hymenolepis*, *Dipylidium*, *Multiceps* etc.), Trematoda (*Schistosomes*, *Fasciola*, *Fasciolopsis*,

*Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis* etc.) and Nematoda (*Trichiuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracuncul* etc.)

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

### **Applied Microbiology**

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

### **B) Affective Domain:**

1. Should be able to function as a part of a team, develop an attitude of cooperation with colleagues, and interact with the patient and the clinician or other colleagues to provide the best possible diagnosis or opinion.

2. Always adopts ethical principles and maintain proper etiquette in dealings with patients, relatives and other health personnel and to respect the rights of the patient including the right to information and second opinion.
3. Develop communication skills to word reports and professional opinion as well as to interact with patients, relatives, peers and paramedical staff, and students for effective teaching.

**C) Psychomotor domain:**

1. Collection/transportation of specimens for microbiological investigations
2. Preparation, examination and interpretation of direct smears from clinical specimens
3. Plating of clinical specimens on media for isolation, purification, identification and quantification purposes.
4. Preparation of stains viz. Gram, Albert's, Ziehl-Neelsen (ZN), Silver impregnation stain and special stains for capsule and spore etc.
5. Preparation and pouring of media like Nutrient agar, Blood Agar, Mac-Conkey agar, Sugars, Kligler iron agar/Triple sugar iron agar (TSI), Robertson's cooked meat broth, Lowenstein Jenson's medium, Sabouraud's dextrose agar etc.
6. Preparation of reagents-oxidase, Kovac etc.
7. Quality control of media, reagent etc.
8. Operation of autoclave, hot air oven, filters like Seitz and membrane filter 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, and incubator 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, Craigie's tube, dark ground microscopy for *Spirochetes*
17. Routine and Special tests - Catalase test, Oxidase test, slide and tube coagulase tests, niacin and catalase tests for *Mycobacterium*, bile solubility, chick cell agglutination, sheep cell haemolysis, satellitism, CAMP test, and other biochemical tests.

18. Preparation of antibiotic discs; performance of antimicrobial susceptibility testing eg. Kirby-Bauer, Stoke's method, Estimation of Minimal Inhibitory/Bactericidal concentrations by tube/plate dilution methods.
19. Tests for  $\beta$ -lactamase production.
20. Screening of gram negative isolates for ESBL and MBL
21. Screening of *Staphylococci* for Methicillin Resistance.
22. Screening of *Enterococci* for Vancomycin resistance.
23. Testing of disinfectants.
24. Quantitative analysis of urine by pour plate method and semi quantitative analysis by standard loop tests for finding significant bacteriuria
25. Disposal of contaminated materials like cultures
26. Disposal of infectious waste
27. Bacteriological tests for water, air and milk
28. Maintenance and preservation of bacterial cultures

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

○ **Knowledge:**

End of 1 <sup>st</sup> year	End of 2 <sup>nd</sup> year	End of 3 <sup>rd</sup> year
<b>GENERAL MICROBIOLOGY:</b> <ol style="list-style-type: none"> <li>1. History and Pioneers in Microbiology</li> <li>2. Microscopy</li> <li>3. Nomenclature and classification of microbes</li> <li>4. Morphology of bacteria and other micro-organisms</li> <li>5. Growth and Nutrition of bacteria</li> <li>6. Bacterial metabolism</li> <li>7. Sterilization and disinfection</li> <li>8. Culture media and culture methods</li> <li>9. Identification of bacteria</li> <li>10. Bacterial toxins</li> <li>11. Bacterial antagonism : Bacteriocins</li> <li>12. Bacterial genetics</li> </ol>	<b>IMMUNOLOGY :Clinical</b> <ol style="list-style-type: none"> <li>1. Hypersensitivity</li> <li>2. Immunodeficiency</li> <li>3. Auto-immunity</li> <li>4. Immune tolerance</li> <li>5. Transplantation immunity</li> <li>6. Tumour immunity</li> <li>7. Immunoprophylaxis and immunotherapy</li> <li>8. Measurement of immunity</li> </ol>	<b>GENERAL MICROBIOLOGY &amp; IMMUNOLOGY:</b>  <b>All</b>

<p>13. Gene cloning</p> <p>14. Antibacterial substances used in the treatment of infections and drug resistance in bacteria</p> <p>15. Bacterialecology - Normal flora of human body, Hospital environment, Air, Water and Milk</p> <p>16. Host-parasite relationship</p>		
<p><b>IMMUNOLOGY :</b></p> <ol style="list-style-type: none"> <li>Innate and acquired immunity</li> <li>Antigens</li> <li>Immunoglobulins</li> <li>Antigen and antibody Reactions</li> <li>Complement System</li> <li>The normal immune system: structure and function</li> <li>Immune Response</li> </ol>	<p><b>SYSTEMATIC BACTERIOLOGY</b></p> <ol style="list-style-type: none"> <li><i>Streptococcus and Lactobacillus</i></li> <li><i>Staphylococcus and Micrococcus</i></li> <li><i>Pseudomonas</i></li> <li><i>The Enterobacteriaceae</i></li> <li><i>Mycobacteria</i></li> <li><i>Corynebacterium</i> and other Coryneform bacteria</li> <li><i>Vibrios, Aeromonas, Plesiomonas, Campylobacter &amp; Spirillum</i></li> <li><i>Neisseria, Branhamella &amp; Moraxella</i></li> <li><i>Haemophilus and Bordetella</i></li> <li><i>Bacillus</i>: the aerobic spore-</li> </ol>	<p><b>SYSTEMATIC BACTERIOLOGY (2<sup>nd</sup> year) :</b></p> <p><b>plus</b></p> <ol style="list-style-type: none"> <li><i>Actinomycetes, Nocardia and Actinobacillus</i></li> <li><i>Erysipelothrix and Listeria</i></li> <li>The <i>Bacteroidaceae</i>: <i>Bacteroides, Fusobacterium and Leptotrichia</i></li> <li><i>Chromobacterium, flavobacterium, Acinetobacter and</i></li> </ol>
	<p>bearing bacilli</p> <ol style="list-style-type: none"> <li><i>Clostridium</i>: the spore-bearing anaerobic bacilli</li> <li>Non-spore anaerobe</li> <li>The <i>Spirochaetes</i></li> </ol>	<p><i>Alkaligenes</i></p> <ol style="list-style-type: none"> <li><i>Pasteurella, Francisella</i></li> <li><i>Brucella</i></li> <li><i>Chlamydia</i></li> <li><i>Rickettsiae</i></li> <li><i>Mycoplasmatales: Mycoplasma, Ureaplasma and Acholeplasma</i></li> <li>Miscellaneous bacteria</li> </ol>
<p><b>MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES</b></p>	<p><b>VIROLOGY:</b></p> <ol style="list-style-type: none"> <li>The nature of viruses</li> <li>Classification of viruses</li> <li>Morphology: virus structure</li> <li>Virus replication</li> </ol>	<p><b>VIROLOGY (2<sup>nd</sup> year): plus</b></p> <ol style="list-style-type: none"> <li>Vaccines</li> <li><i>Pox viruses</i></li> <li><i>Vesicular viruses</i></li> </ol>

<ol style="list-style-type: none"> <li>1. Normal Microbial flora</li> <li>2. Epidemiology of infectious diseases</li> <li>3. Hospital acquired infections &amp; Hospital waste disposal</li> <li>4. Bacteriology of water milk and air</li> </ol>	<ol style="list-style-type: none"> <li>5. The genetics of viruses</li> <li>6. The pathogenicity &amp; lab diagnosis of viruses</li> <li>7. Epidemiology of viral infections</li> <li>8. Anti-viral drugs</li> <li>9. Bacteriophages</li> <li>10. Herpesviruses</li> <li>11. Paramyxoviruses</li> <li>12. Influenza virus</li> <li>13. Hepatitis viruses</li> <li>14. Rabies virus</li> <li>15. Human immunodeficiency viruses</li> </ol>	<ol style="list-style-type: none"> <li>4. <i>Togaviruses</i></li> <li>5. <i>Bunyaviruses</i></li> <li>6. <i>Arenaviruses</i></li> <li>7. <i>Marburg and Ebola viruses</i></li> <li>8. <i>Rubellavirus</i></li> <li>9. <i>Orbiviruses</i></li> <li>10. Respiratory diseases : <i>Rhinoviruses, adenoviruses and corona viruses</i></li> <li>11. Enteroviruses; <i>Polio, Echo, and Coxsackieviruses</i></li> <li>12. Other enteric viruses</li> <li>13. Slow viruses</li> <li>14. Oncogenic viruses</li> <li>15. Teratogenic viruses</li> </ol>
	<p><b>PARASITOLOGY:</b></p> <ol style="list-style-type: none"> <li>1. General Parasitology</li> <li>2. Protozoan parasites of medical importance: <i>Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium</i></li> </ol>	<p><b>PARASITOLOGY (2<sup>nd</sup> year): plus</b></p> <ol style="list-style-type: none"> <li>1. Protozoan parasites of medical importance: <i>Toxoplasma, Sarcocystis, Cryptosporidium, Babesia, Balantidium</i> etc.</li> <li>2. Helminthology: All those medically important helminthes belonging to Cestoda, Trematoda and Nematoda.</li> <li>3. Cestodes: <i>Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipylidium,</i></li> </ol>
		<p><i>Multiceps</i> etc.</p> <ol style="list-style-type: none"> <li>4. Trematodes: <i>Schistosomes, Fasciola, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis</i> etc.</li> <li>5. Nematodes: <i>Trichuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara,</i></li> </ol>

		<p><i>Enterobius, Filarial worms, Dracunculus, etc.</i></p> <p><b>6. Ecto-parasites:</b> Common arthropods and other vectors viz., Mosquito, Sand fly, Ticks, Mite, Cyclops</p>
	<p><b>MYCOLOGY</b></p> <ol style="list-style-type: none"> <li>1. The morphology and reproduction of fungi</li> <li>2. Classification of fungi</li> <li>3. <i>Dermatophytes</i></li> <li>4. <i>Candida</i></li> <li>5. <i>Aspergillus</i></li> </ol>	<p><b>MYCOLOGY (2<sup>nd</sup> year): plus</b></p> <ol style="list-style-type: none"> <li>1. Contaminant and opportunistic fungi</li> <li>2. Fungi causing superficial mycoses</li> <li>3. Fungi causing subcutaneous mycoses</li> <li>4. Fungi causing systemic infections</li> <li>5. Anti-mycotic agents</li> </ol>
		<p><b>MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES</b></p> <ol style="list-style-type: none"> <li>1. Infections of various organs and systems of human body</li> <li>2. Molecular genetics as applicable to microbiology</li> <li>3. Vaccinology: principle, methods of preparation, administration of vaccines.</li> <li>4. Bio-terrorism</li> </ol> <p><b>ALLIED BASIC SCIENCES</b></p>
		<p><b>(a) Biochemistry:</b> Basic understanding of biochemistry as applied to immunological/ molecular methods for study of microbial diseases and pathogenesis of infections.</p> <ol style="list-style-type: none"> <li>1. Protein purification and estimation</li> </ol>

		<p>2. Protein estimation</p> <p>3. Nucleic acid purification and characterization</p> <p>4. Agarose and polyacrylamide gelelectrophoresis - principles</p> <p>5. Ultracentrifugation – principles</p> <p>6. Column chromatography – principles</p> <p><b>(b) Molecular biology:</b> Basic knowledge as applicable to molecular diagnostics and molecular epidemiology.</p> <p>1. Recombinant DNA technology</p> <p>2. Southern, northern and western blotting</p> <p>3. DNA amplification techniques</p> <p>4. Diagnostic PCR, different methods of PCR product detection (liquid hybridization, ELISA).</p> <p>5. Genotyping of microbes and viruses</p> <p><b>(c) Pathology: (as applied to Microbiology)</b> Basic knowledge of</p> <p>1. Inflammation and repair</p> <p>2. Intercellular substances and</p>
		<p>reaction</p> <p>3. Pathological changes in the body in bacterial, viral, mycotic and parasitic infections</p> <p>Demonstration of pathogen in tissue section</p>

○ **Skills:**

1 <sup>st</sup> 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	1 0	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	1 0	-	-
	14	Maintenance of stock cultures	1 0	-	-
Staining	1	Gram staining	1 0	20	30
	2	Acid fast staining ( Ziehl-Neelsen method)	1 0	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 C.	2	2	2

		<i>parvum</i>			
Serology/ Immunology	1	Phlebotomy & separation of serum	10	10	5
	2	Operation & maintenance of mini-VIDAS	5	10	20
	3	Operation & maintenance of ELISA reader & washer	5	10	--
		<b>Performance of serological tests</b>			
	1	Latex agglutination test(RA, ASO)	10	20	30
	2	RPR card test	10	20	30
	3	Tube agglutination test	10	20	30
	4	Gold conjugate Rapid card test	10	20	30
	5	ANA by IF	5	5	--
	6	ANA by Immunoblot	5	5	--
	7	IQC-serology	5	5	5

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

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

	12	Handling of laboratory animal	-	-	10
	13	Methods for preservation of bacteria	-	-	10
	14	Maintenance of stock cultures	-	-	10
Staining	1	Gram staining	--	--	30
	2	Acid fast staining ( Ziehl- Neelsen method)	--	--	30
	3	Albert staining	--	--	05
	4	Modified ZN staining for <i>M. leprae</i>	--	--	5
	5	Modified ZN staining for <i>Nocardia</i>	--	--	5
	6	IQC-staining	--	--	5
Media preparation	1	Preparation of stains	--	--	10
	2	Preparation of reagents	--	--	15
	3	Preparation, pouring & Quality Control (QC) of culture media	--	--	50
	4	Operation & maintenance of autoclave	--	--	20
Bacteriology	1	Specimen collection for Blood Culture	--	--	5
	2	Inoculation of liquid & solid media	--	--	30
	3	Identification test	--	--	30
	4	Antimicrobial sensitivity testing- modified Kirby-bauer technique	--	--	30
	5	IQC- Antibiotic disc potency	--	--	5
	6	Operation of BacT/ALERT	--	--	20
	7	Operation of Vitek 2 compact	--	--	20
	8	Petroff's concentration	--	--	20

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

## KIMSDU/KIMS/CURRICULUM/MD/MICROBIOLOGY/PROGRAMME /COURSE

At the end of 3 yrs the PG Students shall be able to:

- 1) To commit to effective utilization of resources and continuous improvement in the provision of an infection free atmosphere for the well being of patients and healthcare workers. Identify the microorganism isolated from patient's sample by using various media and biochemical tests.
- 2) To enquire latest diagnostic modalities of investigations in the field of Microbiology.
- 3) To formulate policies and protocols on the methods of sterilization and disinfection.
- 4) To incorporate quality improved principles in the effective infection control for the benefit of patients and health care workers
- 5) To implement an effective antibiotic policy to control the spread of antibiotic resistance.
- 6) To create awareness healthcare workers regarding biomedical waste management
- 7) To give the society competent clinical microbiologists with thorough and updated knowledge in the field of Microbiology.

### **Syllabus**

#### **Course contents:**

#### **Paper I: General Microbiology**

1. History of microbiology
2. Microscopy
3. Bio-safety including universal containment, personal protective equipment for biological agents
4. Physical and biological containment
5. Isolation precautions including standard precautions and transmission based precautions
6. Sterilization, disinfection and lyophilization
7. Morphology of bacteria and other microorganisms
8. Nomenclature and classification of microorganisms
9. Normal flora of human body
10. Growth and nutrition of bacteria
11. Bacterial metabolism
12. Bacterial toxins
13. Bacteriocins
14. Microbiology of hospital environment
15. Microbiology of air, milk and water

16. Host-parasite relationship
17. Antimicrobial agents and mechanisms drug resistance
18. Bacterial genetics and bacteriophages
19. Molecular genetics relevant for medical microbiology
20. Quality assurance and quality control in microbiology
21. Accreditation of laboratories

## **Immunology**

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

## Paper II: Systematic bacteriology

1. Isolation and identification of bacteria
2. Gram positive cocci of medical importance including *Staphylococcus*, *Micrococcus*, *Streptococcus*, *anaerobic cocci* etc.
3. Gram negative cocci of medical importance including *Neisseria*, *Branhamella*, *Moraxella* etc.
4. Gram positive bacilli of medical importance including *Lactobacillus*, *Coryneform organisms*, *Bacillus* and *aerobic bacilli*, *Actinomyces*, *Nocardia*, *Actinobacillus* and *other actinomycetales*, *Erysipelothrix*, *Listeria*, *Clostridium* and other spore bearing anaerobic bacilli etc.
5. Gram negative bacilli of medical importance including *Vibrios*, *Aeromonas*, *Plesiomonas*, *Haemophilus*, *Bordetella*, *Brucella*, *Gardnerella*, *Pseudomonas* and *other non-fermenters*, *Pasteurella*, *Francisella*, *Bacteroides*, *Fusobacterium*, *Leptotrichia* and *other anaerobic gram negative bacilli* etc.
6. *Helicobacter*, *Campylobacter*, *Calymmatobacterium*, *Streptobacillus*, *Spirillum*  
And miscellaneous bacteria
7. Enterobacteriaceae
8. Mycobacteria
9. Spirochetes
10. Chlamydia
11. Mycoplasma tales; *Mycoplasma*, *Urea plasma*, *Acholeplasma* and other *Mycoplasmas*.
12. *Rickettsia*, *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*, and *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* (*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, 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, Rhabdoviruses, Arena viruses, Bunya viruses, Retro viruses, Filo viruses, Human immunodeficiency virus, Arbo viruses, Corona viruses, Calci viruses etc.
10. Slow viruses including prions
11. Unclassified viruses
12. Hepatitis viruses
13. Virioids, prions
14. Vaccines and anti-viral drugs.

## **Parasitology**

1. General characters and classification of parasites.
2. Methods of identification of parasites
3. Protozoan parasites of medical importance including *Entamoeba*, *Free living amoebae*, *Giardia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Toxoplasma*, *Sarcocystis*, *Cryptosporidium*, *Microsporidium*, *Cyclospora*, *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

## **TEACHING AND LEARNING METHODS**

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

### **Post Graduate Training Programme teaching methodology**

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

### **Rotation:**

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

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

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

#### **Within Department**

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

## 7. Media preparation

### **Other Departments**

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

### **Practical training**

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

### **Skills & performance**

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

### **Emergency duty**

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

### **Training in research methodology**

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

The thesis is aimed at training the post graduate student in research methods and techniques. It should include identification of a research question, formulation of a

hypothesis, search and review of relevant literature, getting acquainted with recent Advances, designing of research study, collection of data, critical analysis of the results and drawing conclusions. The thesis should be completed and submitted by the student six months before appearing for the final university examination.

### **Communication and attitudinal skills**

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

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

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

- Postgraduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.
- Department should encourage e-learning activities.

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

#### **EXAMINATION PATTERN:**

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

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

##### **General Principles**

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

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

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

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

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

The summative examination would be carried out as per the Rules given in

**POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.**

The post-graduate examinations should be in three parts:

## 1. Thesis.

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

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

## 2. Theory Examination

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

There should be four theory papers:

<b>PaperI:</b>	General Microbiology and Immunology
<b>PaperII:</b>	Systematic Bacteriology
<b>PaperIII:</b>	Virology Parasitology and Mycology
<b>PaperIV:</b>	Applied Microbiology and Recent advances

## 3. Practical and Oral/viva voce Examination

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

- **Bacteriology:**

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



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
		1 2 3	4 5 6	7 8 9	
1.	Journal based / recent advances learning				
2.	Patient based /Laboratory or Skill based learning				
3.	Self directed learning and teaching				
4.	Departmental and interdepartmental learning activity				
5.	External and Outreach Activities / CMEs				
6.	Thesis / Research work				
7.	Log Book Maintenance				

Publications Yes/No

Remarks\* \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

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

SIGNATURE OF ASSESSEE      SIGNATURE OF CONSULTANT      SIGNATURE