

## M.Sc. (Medical Microbiology)

The aim of this course is to train the students of in the field of Medical Diagnostic Microbiology. Knowledge and practical skills shall be acquired by the candidates in the sub-specialities of Bacteriology including Mycobacteriology, Virology, Parasitology, Immunology, Serology & Mycology so as to be able to deal with diagnosis and prevention of infectious diseases in the community. They will be trained in basic research methodology including molecular biology so that they are able to conduct fundamental and applied research. They will also be trained in teaching methods so that they can take up teaching assignments.

### **GOAL:**

The goal of the postgraduate medical education shall be to produce a competent specialist and medical teacher:

- Who shall recognize the health needs of the community and carry out professional obligations ethically in keeping with the objectives of the national health policy;
- Who shall have mastered most of the competencies, pertaining to medical diagnostic Microbiology that are required to be practiced at the secondary and the tertiary levels of the health care delivery system;
- Who shall be aware of the contemporary advances and developments in the field of medical and diagnostic Microbiology
- Who shall have acquired the spirit of scientific inquiry and is oriented to the principles of research methodology and epidemiology
- Who shall have acquired the basic skills of teaching of the medical and paramedical professionals.

### **EDUCATIONAL OBJECTIVES:**

#### **KNOWLEDGE:**

At the end of the course the students shall be able to:

1. State and explain the etiology, pathogenesis and methods of laboratory diagnosis of infectious diseases and apply that knowledge in the treatment, prevention and control of communicable diseases caused by micro-organisms.

2. State and explain the principles of immunity and immunological phenomenon which help to understand the pathogenesis, laboratory diagnosis of infectious and non-infectious diseases.
3. Establish and practice “laboratory medicine” for diagnosis of infectious diseases in hospitals and community in the field of bacteriology, parasitology, virology, mycology, serology and immunology in the light of clinical findings.
4. Organize the prevention and control of communicable diseases in the community.
5. Understand and practice the principle of prevention and control of health care associated infections and rational antibiotic policy.
6. State the recent advances in the field of Medical Microbiology and apply this knowledge in understanding aetiopathogenesis and diagnosis of diseases caused by micro-organisms.
7. Carry out fundamental or applied research involving microbiological work.
8. Undertake teaching assignments in the subject of medical Microbiology.

#### **(B) Skills**

At the end of the course the student shall be able to

1. Plan the laboratory investigations for the diagnosis of infectious diseases
2. Perform laboratory procedures to arrive at the etiological diagnosis of infectious diseases caused by bacteria, fungi, viruses and parasites including the drug sensitivity profile.
3. Perform and interpret immunological and serological tests.
4. Operate routine and sophisticated instruments in the laboratory.
5. Develop microteaching skills and Pedagogy
6. Successfully implement the chosen research methodology

#### **COURSE CONTENT (SYLLABUS)**

#### **DURATION OF COURSE:**

The minimum period of training shall be three calendar years. No exemption shall be given from this period of training of three years either for any other experience or diploma.

**TRAINING PROGRAMME:**

The candidates joining the course must work as full time resident during the whole period of their postgraduate training. They will be required to attend a minimum of 80% of training period. Candidate shall be given full time responsibility and assignments and their participation in all facets of the educational process assured.

Postgraduate students must maintain a record book of the work carried out by them and the training undergone by them during the period of training. These record books shall be checked and assessed by the faculty.

**TEACHING /LEARNING METHODS:**

Learning in M. Sc. (Medical microbiology) will essentially be self-learning. Following teaching-learning methods shall be followed-

**Group teaching sessions:**

- Journal review
- Subject seminar presentation
- Group discussion
- Presentation of the findings of an exercise on any of the sub-specialities
- Participation in CME programs and conferences

**Hands on experience (practical training)**

Practical training shall be imparted by posting the students in various subspecialities (sections) as detailed in the intrinsic and extrinsic rotation.

Student shall be actively involved in day to day working of all the sections.

He/she will be trained under the guidance of teachers in all the aspects of 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.

**Suggested schedule of rotation:**

1. Bacteriology(Aerobic and anaerobic)	8 months
2. Mycobacteriology	3 months
3. Hospital infection surveillance	2 months
4. Serology/Immunology	6 months
5. Mycology	4 months
6. Virology/HIV	4 months
7. Parasitology	3 months
8. Media preparation	4 months
9. Molecular Diagnostics	2 month

**Total:- 36 months**

**Emergency duty:**

Student shall be posted for managing emergency laboratory services in Microbiology. He/she will deal with all the emergency investigations in Microbiology.

**Teaching experience:**

Student shall be actively involved in the teaching of undergraduate students. He/she will be trained in teaching methods and use of audiovisual aids.

**BROAD AREAS OF STUDY**

General Microbiology; Systematic Bacteriology, Mycology, Virology, Parasitology; Serology, Immunology, molecular diagnostics and Applied Clinical Microbiology including recent advances in Microbiology.

**GENERAL MICROBIOLOGY**

1. History and pioneers in Microbiology
2. Microscopy
3. Morphology of bacteria and other micro-organisms.
4. Nomenclature and classification of microbes.
5. Growth and nutrition of bacteria.
6. Bacterial metabolism.
7. Sterilization and disinfection.
8. Biomedical waste disposal
9. Bacterial toxins.
10. Bacterial antagonism: Bacteriocins.
11. Bacterial genetics, gene cloning.

12. Antibacterial substances used in treatment of infections and drug resistance in bacteria.
13. Bacterial ecology-normal flora of human body, hospital environment, air, water and milk
14. Host parasite relationship.
15. Quality control and Quality Assurance in Microbiology.
16. Laboratory Biosafety
17. Health care associated infections- prevention and control.

### **IMMUNOLOGY AND APPLIED ASPECTS**

1. The normal immune system.
2. Innate immunity.
3. Antigens.
4. Immunoglobulins.
5. Complement.
6. Antigen and antibody reactions.
7. Hypersensitivity.
8. Cell mediated immunity.
9. Immunodeficiency.
10. Autoimmunity.
11. Immune tolerance.
12. Transplantation immunity.
13. Tumour immunity.
14. Prophylaxis and immunotherapy
15. Measurement of immunity.
16. Immunity and immunopathogenesis of specific infectious diseases
17. Molecular Biology Techniques. For e.g. PCR, DNA probes.

### **SYSTEMATIC BACTERIOLOGY**

1. Isolation, description and identification of bacteria. The epidemiology, pathogenesis, antigenic characteristics and laboratory diagnosis of disease caused by them
2. Staphylococcus and Micrococcus; Anaerobic Gram positive cocci.
3. Streptococcus and Lactobacillus.
4. Neisseria, Branhamella and Moraxella.
5. Corynebacterium and other coryneform organisms.

6. Bacillus: the aerobic spore-bearing bacilli.
7. Clostridium: the spore-bearing anaerobic bacilli.
8. Non-sporing anaerobes
9. The Enterobacteriaceae.
10. Vibrios, Aeromonas, Plasiomonas, Campylobacter and Spirillum, H.pylori
11. Erysipelothrix and Listeria
12. Pseudomonas.
13. Chromobacterium, Flavobacterium, Acinetobacter and Alkaligens.
14. Pasteurella, Francisella.
15. Haemophilus and Bordetella.
16. Brucella.
17. Mycobacteria.
18. The spirochaetes.
19. Actinomyces, Nocardia and Actinobacillus.
20. Mycoplasmatales: Mycoplasma, Ureaplasma and Acholeplasma.
21. Rickettsiae.
22. Chlamydiae.
23. Emerging bacterial pathogens.

## **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 of viruses
7. Epidemiology of viral infections
8. Vaccines and antiviral drugs
9. Bacteriophages
10. Pox viruses
11. Herpes viruses
12. Togaviridae
13. Bunyaviridae
14. Arenaviridae
15. Marburg and Ebola viruses
16. Rubella virus

17. Orbi viruses
18. Influenza virus
19. Respiratory disease: Rhinoviruses, adenoviruses, corona viruses
20. Paramyxoviridae
21. Enteroviruses : Polio, Echo, Coxsackie viruses
22. Hepatitis viruses
23. Rabies virus
24. Slow viruses
25. Human immunodeficiency viruses
26. Oncogenic viruses
27. Viruses of gastroenteritis
28. Prion diseases
29. Emerging viral infections - SARS, Avian influenza, H1N1.

#### **PARASITOLOGY**

1. Protozoan parasites of medical importance : Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma, Sarcocyst Cryptosporidium, Balantidium, Isospora, Cyclospora, Microsporidium
2. Helminthology : All those medically important helminths belonging to Cestoda, Trematoda and Nematoda.  
 Cestodes : Diphyllbothrium, Taenia, Echinococcus, Hymenolepis, Dypylidium, Multiceps etc.  
 Trematodes : Schistosomes, Fasciola, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis etc.  
 Nematodes : Trichuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus, etc.
3. Ectoparasites : Common arthropods and other vectors viz., Mosquito, Sandfly, Ticks, Mite, Cyclops.

#### **MYCOLOGY**

1. The morphology and reproduction of fungi and antimycotic agents
2. Classification of fungi
3. Contaminant and opportunistic fungi
4. Fungi causing superficial mycoses and. subcutaneous mycoses
5. Fungi causing systemic infections

## **APPLIED CLINICAL MICROBIOLOGY**

1. Epidemiology of infectious diseases
2. Hospital acquired infections
3. Infections of various organs and systems of the human body
4. Molecular genetics as applicable to Microbiology
5. Automation in Microbiology
6. Rapid diagnostic techniques for microbial diseases.
7. Vaccinology : principle, methods of preparation, administration of vaccines
8. Outbreak investigations & disaster management
9. Biological warfare

## **PRACTICALS (SKILLS)**

### **BACTERIOLOGY**

#### **Must acquire:**

1. Care and operation of Microscopes viz. Light, Dark ground, Phase contrast, Inverted, Fluorescent microscopes.
2. Preparation of stains viz. Gram's, Albert's, Ziehl- Neelson and other special stains - performing of staining and interpretation of stained smears.
3. Washing and sterilization of glassware including plugging and packing.
4. Operation of incubator, autoclave, hot air oven, inspissator, distillation plant, filters like Seitz and membrane and sterility tests.
5. Care and maintenance of common laboratory equipments like water bath centrifuge, refrigerators, incubators etc.
6. Preparation and pouring of liquid and solid media - Nutrient agar, Blood agar, MacConkey agar, sugars, TSI agar, Robertson's cooked meat, Lowenstein-Jensen's, selective media.
7. Preparation of reagents - oxidase, Kovac, etc.
8. Tests for beta-lactamases including ESBLs.
9. Collection of specimens for Microbiological investigations such as blood, urine, throat swab, rectal swab, stool, pus, OT specimens.
10. Preparation, examination and interpretation of direct smears from clinical specimens, viz. Sputum for AFB - ZN & auramine O, slit smears for *M. leprae*, - ZN stain, conjunctival smear for Chlamydiae - Giemsa/Iodine.
11. Techniques of anaerobiosis - Gaspack system, anaerobic jars-evacuation & filling with H<sub>2</sub>, CO<sub>2</sub>



12. Identification of bacteria of medical importance upto species level (except anaerobes - upto generic level)
13. Quantitative analysis of urine by pour plate method and semiquantitative analysis by standard loop test for significant bacteriuria.
14. Plating of clinical specimens on media for isolation, purification identification and quantitation.
15. Tests for motility: hanging drop, Craige's tube, dark ground microscopy for Spirochaetes - Treponema & Leptospira.
16. In-vitro toxigenicity tests - Elek test, Nagler's reaction
- 17 Special tests - Bile solubility, chick cell agglutination, sheep cell haemolysis, niacin and catalase tests for mycobacterium, satellitism, CAMP test, catalase test and slide agglutination tests, and other as applicable for identification of bacteria upto species level
18. Performance of antimicrobial susceptibility testing by Kirby-Bauer disk diffusion method; estimation of Minimum inhibitory/Bactericidal concentrations by tube/plate dilution methods. Tests for drug susceptibility of Mycobacterium tuberculosis
19. Testing of disinfectants- Phenol coefficient and 'in use' tests.
20. Quality control of media reagents etc. and validation of sterilization procedures.
21. Aseptic practices in laboratory and safety precautions.
22. Disposal of contaminated material like cultures.
23. Bacteriology of food, water, milk, air
24. Maintenance of stock cultures.

**Desirable to acquire:**

1. Techniques of withdrawal of blood from laboratory animals including sheep.
2. Inoculation of infective material in animals by different routes and testing for pathogenicity.
3. Performance of autopsy on animals.
4. Conjugation experiments for transfer of drug resistance
5. Bacteriocine typing eg. Pyocine, Proteocin etc.
6. Mouse foot pad test for *M. leprae*

## **IMMUNOLOGY/ SEROLOGY**

1. Collection of blood by venepuncture, separation of serum and preservation of serum for short and long periods.
2. Preparation of antigens from bacteria or tissues for widal, Weil-Felix, VDRL, etc. and their standardisation.
3. Preparation of adjuvants like Freund's adjuvant.
4. Raising of antisera in laboratory animals.
5. Performance of serological tests viz. Widal, Brucella tube agglutination, indirect haemagglutination, VDRL, Paul-Bunnell, Rose-Waaler, IFA.
6. Performance and interpretation of Enzyme linked immunosorbent assay.
7. Latex and staphylococcal co-agglutination tests.

### **Desirable to acquire:**

1. Leucocyte migration inhibition test.
2. T-cell rosetting.
3. Flow Cytometry
4. Immunodiffusion in gels, counter immunoelectrophoresis- visualization and interpretation of bands.
5. Radial immunodiffusion.
6. Immunoelectrophoresis.

## **MYCOLOGY**

### **Must acquire:**

1. Collection of specimens for mycology.
2. Direct examination of specimens by KOH, Gram, Kinyoun's, Giemsa, Lactophenol cotton blue stains.
3. Isolation and identification of pathogenic yeasts and moulds and recognition of common laboratory contaminants.
4. Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture.
5. Maintenance of stock cultures.

## **PARASITOLOGY**

### **Must acquire:**

1. Examination of faeces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formol - ether methods) and complete examination for other cellular features.
2. Egg counting techniques for helminths.
3. Examination of blood for protozoa and helminths by wet mount, thin and thick stained smears.
4. Examination of other specimens for e.g. urine, C.S.F., bone marrow etc. for parasites.
5. Performance of stains - Leishman, Giemsa, Modified Acid Fast, Toluidine Blue O.
6. Identification of common arthropods and other vectors viz. Mosquito, sand fly, ticks, mite and cyclops.
7. Preservation of parasites - mounting, fixing, staining etc.

### **Desirable to acquire:**

1. In-vitro culture of parasites like entamoeba, leishmania, P.falciparum.
2. Maintenance of toxoplasma gondii in mice.
3. Preparation of media - NIH, NNN etc.
4. Copro-culture for larva of hook worms.
5. Antigen preparation viz. Entamoeba , Filarial , Hydatid for serological tests like IHA and skin test like Casoni's .
6. Permanent staining techniques like iron haematoxylin

## **VIROLOGY**

### **Must acquire:**

1. Preparation of glassware for tissue culture(washing, sterilization)
2. Preparation of media like Hanks, MEM.
3. Preparation of clinical specimens for isolation of viruses.
4. Serological tests-ELISA and rapid tests for HIV, RPHA for HbsAg, Haemagglutination inhibition for influenza, AGD and counterimmunoelectrophoresis for detection of viral antigens or antiviral antibodies.
5. Handling of mice, rats, guinea pigs, rabbits for collection of blood, pathogenicity test etc.

**Desirable to acquire:**

1. Preparation of Monkey Kidney Cells (Primary) maintenance of continuous cell lines by subcultures. Preservation of cell cultures.
2. Recognition of CPE in tissue cultures.
3. Performance of haemadsorption, haemagglutination, immunofluorescence, neutralization tests for identification of viruses.
4. Chick embryo techniques- inoculation and harvesting

**SUGGESTED READING:****Reference books (Please refer the most recent edition)**

1. Topley and Wilson's Microbiology and Microbial infections. 8 volumes 2005 10<sup>th</sup> edition
2. Color Atlas and Textbook of Diagnostic Microbiology: Elmer W Koneman -2006, 6<sup>th</sup> edition
3. Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases-2004, 6<sup>th</sup> edition
4. Microbiology and Clinical Practice: Shanson-1999, 3<sup>rd</sup> edition
5. Immunology: Janis Kuby- 2003.
6. Basic Clinical Immunology. Fudenburg, Stites, Caldwell, Weils.
7. Control of Hospital Infection- A practical handbook (most recent edition)-2000,4<sup>th</sup> edition
8. Bailey and Scott's Diagnostic Microbiology.
9. Text book of Parasitology - Chatterjee K.D.
10. Microbiology in Clinical Practice Shanson D.C.
11. Text book of Parasitology - P.C.Beaver
12. Text book of microbiology -Ananthanarayan
13. Text book of microbiology - P. chakraborty
14. Text book of Parasitology - Damale & Karyakante
15. Mackie & MacCartney's Practical microbiology

**Further Reading**

1. Mycology - Rippons
2. Essentials of Immunology- Roitt
3. Virology- Clinical Virology by Rich
4. Gradwohl's Clinical Laboratory Methods and Diagnosis.

5. Biochemical tests for the Identification of Medical Bacteria-  
MacFaddin JF
6. Manual of Clinical Microbiology- ASM press

### **Journals**

1. Indian Journal of Medical Microbiology
2. Clinical Microbiology Reviews
3. Journal of Clinical Microbiology
4. Journal of Medical Microbiology
5. Journal of AIDS
6. Infection Control and Hospital Epidemiology
7. Indian Journal of Tuberculosis
8. Lancet-Infectious Diseases
9. Emerging Infectious Diseases-online

### **EVALUATION :**

Evaluation shall be done on the basis of Theory and Practical examination.

#### **PASSING:**

Minimum of 50% marks in theory in all papers taken together and 50% marks in practical shall be necessary for passing.

#### **THEORY:**

Theory will consist of FOUR papers with following distribution , each paper will be of three hours duration and 100 marks.

PAPER I	General Microbiology & Immunology	100 marks
PAPER II	Systemic Bacteriology	100 marks
PAPER III	Mycology & Virology	100 marks
Paper IV	Parasitology	100 marks

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Total- 400 marks

#### **FORMAT:**

All papers will have the following format

Long answer question with applied aspects and recent advances.

1. Long Answer question - 25 marks
2. Long Answer question - 25 marks
3. Short Answer questions ( 5 out of 6 ) - 50 marks

Total- 100 marks

**PRACTICAL:**

**DURATION:** Practical examination shall be conducted on THREE consecutive days. The time shall be adjusted by the examiners to cover all exercises.

**EXERCISES:** The practical examination will consist of following exercises conjointly conducted and evaluated by the four examiners (Two internals and two externals).

**EXERCISES: A. Long Exercise:**

Exercise in Clinical Bacteriology: Problem Solving Exercise: where a brief history along with relevant clinical findings should be given. Student should be asked to list relevant investigations required & clinical specimen to be given. Isolation and identification of bacteria from the given clinical specimen and antimicrobial sensitivity of the isolated organism to be performed.

**B. Short Exercises:**

1. Exercise in Bacteriology. Identification of bacteria in given pure culture.
2. Exercise in Virology -ELISA for HIV/ELISA for detection of HbsAg .any rapid test for HIV antibodies or any other serological test for detection of viral antigen/antibody.
3. Exercise in mycology -Identification of fungi in minimum two given cultures- one yeast and one mould.
- 4 Exercise in Parasitology.

Any one of the following exercises to be performed -

- Examination of stool for ova/cyst by direct/ concentration method.
- Preparation of peripheral smear and staining by Leishman stain.  
Reporting of parasites in the prepared/given smear.

5.Exercise in Immunology/Serology:

- Any one of the Serology/Immunology techniques commonly used in diagnostic clinical microbiology to be performed. Serological test - (For e.g. Latex agglutination(ASO, CRP, RA etc.), tube agglutination (Widal, Brucella, Paul-Bunnell etc.), slide flocculation (VDRL), Passive haemagglutination(e.g. TPHA), Dot blot assay (e.g. HIV Rapid test).

NOTE: The test to be performed in this exercise should be different in

serological / immunological principle from that performed in Exercise 2.  
 Parallel testing of given exercise shall be done at the examination centre for checking the quality of chemicals, media, reagents and the test material.

**ORAL (VIVA -VOCE)**

Student will be examined by all the examiners together regarding his knowledge of basic aspects and recent advances in the field of microbiology and its subspecialities. Student will be assessed about his comprehension, analytical approach, expression, interpretation of data and his approach in solving the problem.

**DAY WISE DISTRIBUTION OF EXERCISES:**

DAY 1	DAY 2	DAY 3
Long exercise	Long exercise (contd.)	Long exercise (contd.)
Short exercise	Short exercise ( complete )	Oral ( Viva-voce)
Exercise in mycology	Exercise in Virology	
Exercise in Parasitology	Serology/Immunology	

Day-wise distribution of exercises may be changed as per the convenience of the examiners.

**MARKING PATTERN FOR PRACTICAL & ORAL EXAMINATION.**

EXERCISE /VIVA	MAXIMUM MARKS
A) Long Exercise (Bacteriology)	100
B) SHORT EXERCISES	
Short Exercise (Bacteriology)	60
Exercise in Virology	50
Exercise in Mycology	40
Exercise in Parasitology	30
Serology /Immunology	50
C) ORAL (VIVA VOCE)	70
<b>TOTAL A,B,C</b>	<b>400</b>