

POST GRADUATE CURRICULUM

1. Programme objectives :

- a. Capable of offering a high quality diagnostic opinion in a given clinical situation with an appropriate and relevant sample of blood, urine, pus, CSF, fecal samples body fluids etc. for the purpose of diagnosis and overall wellbeing of the ill.
- b. Able to make independent decisions in routine diagnostic bacteriology, parasitology, mycology ,virology and immunology
- c. To be able to teach and share his knowledge and competence with others. He should be conversant in modern methods of medical education and teaching.
- d. Should be familiar with current developments and advances in the field of microbiology
- e. Capable of pursuing clinical and laboratory based research.

2. Specific learning objectives:

- a. cognitive domain
 - i. Diagnose routine and complex clinical problems in the field of bacteriology, parasitology, mycology, virology, immunology.
 - ii. Should be able to identify problems in the laboratory and offer solutions thereof so that high order of quality control is maintained
 - iii. Subject himself/herself to continuing education and constantly update his/her knowledge of recent advances in microbiology and allied subjects
 - iv. The teaching program must be more clinical oriented to include ward rounds, clinical, case discussion, and active participation in infection control activity of the institution.
 - v. Advice on the nature of appropriate specimens and the tests necessary to arrive at diagnosis in a difficult and problematic case
 - vi. Maintain accurate records of tests and their results for reasonable periods of time so that these may be retrieved as and when necessary
 - vii. Make and record observations systematically that is of use of archival purposes and for furthering the knowledge of microbiology.

b. Psychomotor domain

- i. Able to perform most of the routine tests in microbiology laboratory including specimen processing like staining, biochemical investigation , antibiotics susceptibility testing, serotyping, serological tests etc.
- ii. Able to collect specimens like throat swab, blood, purulent fluids, nasopharyngeal swab, urine, nail clippings etc.
- iii. Practical training in identification of infectious agents(bacterial, parasitic, viral and fungal)
- iv. Introduction of concept of application/role of bioinformatics in microbiology. This must be taken as common lecture for all the postgraduates during their tenure as an invited lecture by an expert or bioinformatics department.
- v. The post graduate must be trained in various molecular techniques such as plasmid/chromosomal DNA isolation, PCR, solid phase hybridization. Practical training in run gel electrophoresis etc. to be imparted
- vi. Should be familiar with the function, handling and routine care of equipments in the laboratory
- vii. Carry out research using basic research methodology so that they can conduct fundamental and applied research.
- viii. Should be capable of effectively disposing laboratory waste to ensure minimization of risk to infection and accidents to laboratory personnel
- ix. Able to systematically write a paper and publish in a journal.
- x. Able to present a paper in a conference through an oral presentation and poster presentation.
- xi. Active participation in infection control activity of the institute

c. Affective domain

- i. To correlate clinical and microbiological data so that various clinical signs and symptoms or manifestations of disease can be interpreted
- ii. Should be able to teach microbiology to undergraduates, postgraduates, nurses, and paramedical staff including laboratory personnel.
- iii. Should be able to function as part of team that is essential for the diagnosis and management of the patient. He /she should therefore develop an attitude of cooperation with his/her colleagues which is necessary for this purpose. It is implied that he/she whenever necessary interact with the patient and the clinician or other colleagues to provide the best possible diagnosis or opinion

- iv. Always adopt ethical principles and maintain proper etiquette in his/her dealings with patients , relatives and other health personnel
- v. Respect the rights of the patient including the right to information and second opinion
- vi. Provide leadership and inspire members of the team with whom he/she is involved within the field of microbiology , teaching and research
- vii. Develop communication skills not only to word reports and professional opinions but also to interact with patients , relatives, peers and paramedical staff
- viii. Able to supervise and work with subordinates and colleagues in a laboratory

3. Post graduate training:

a. Duration of course

- i. The course of Doctor of Medicine (Microbiology) will be of three years duration in the form of residency programme that is full time

b. Eligibility

- i. The essential qualification will be MBBS degree of any Indian University/ Deemed university/ Autonomous institution etc. as recognized by the Medical Council of India
- ii. Any other qualification of a foreign university that is recognized by the MCI and the concerned university as equivalent to the MBBS degree

c. Selection

- i. The selection will be made on the basis of an entrance examination conducted by University of Delhi 50% state quota and by AIIMS for 50% All India Quota with multiple choice questions of the level of MBBS , including all subjects of the MCI recognized MBBS course

d. Training programme

While professional training in all branches is equally important , since they are interdependent and competitive, a balance of emphasis is desirable. Active learning should form the mainstay of postgraduate training there should be lectures for postgraduates (at least 10 per year) along with seminars, symposia, group discussions, journal clubs in which the post

graduate should actively participate and present. The three year training programme for the MD degree may be arranged in the form of postings to different laboratories for specified period as outlined below. 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

Laboratory	Duration in months
Routine bacteriology- pus seat	3 months
Routine bacteriology- blood seat	3 months
Routine bacteriology – urine seat	3 months
Media room	2 months
Antibiotic sensitivity testing lab.	3 months
Enterobacteriaceae	3 months
Parasitology	3 months
Anaerobic lab	2 months
Serology	3 months
Mycology	3 months
Virology	3 months
HIV lab	2 months
Mycobacteriology	3 months
Total	36 months

e. Scope of training

The training programme is designed to enable the student to acquire a capacity to learn and investigate for himself, to synthesize and integrate set of facts and develop a faculty to reason. The curriculum programmes 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.

- i. All post graduate students to maintain a logbook for record keeping of all the practical experiments performed during their training course. Clinical round to be arranged for the PG

students once or twice a week in coordination with the clinical faculty for a more comprehensive and meaningful interaction/training of different clinical situations (Surgery, medicine, pediatrics). The respective Head of the Department must sign the logbook. This is to be deposited with the respective institute at the end of their term

- ii. Practical training in histopathology of infectious agents with tissue identification (bacterial, viral, fungal and parasitic) for final year M.D. students for one week at their respective institute in coordination with the pathology department
- iii. Introduction of concept of application/role of bioinformatics in microbiology. This must be taken as a common lecture for all the postgraduates during their tenure as an invited lecture by an expert or bioinformatics department
- iv. Molecular techniques have important role in the diagnostics and characterization of infectious diseases, the postgraduate must be trained in various molecular techniques such as plasmid/chromosomal DNA isolation, PCR, solid phase hybridization. Practical training must include training in molecular techniques
- v. The teaching program must be more clinical oriented to include ward rounds, clinical, case discussion
- vi. Ethical issues in microbiology practice and research should be included in the course
- vii. Practical training to run gel electrophoresis

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

- i. Collection of specimens including throat swab, nasopharyngeal swab, blood sample, pus sample nail clippings, urine specimen etc.
- ii. Processing of specimens
- iii. Culture of specimens
- iv. Antibiotic sensitivity testing
- v. Direct microscopic examination of smears
- vi. Biochemical tests for identification of bacteria
- vii. Serological tests for identification of various pathogens
- viii. Presentation and work up of cases including the identification of special stains and procedures needed
- ix. Conferences and seminars , continuing medical education programmes
- x. Journal club
- xi. Research presentation and review of research work
- xii. Use and maintenance of equipments
- xiii. Maintenance of records
- xiv. Teaching undergraduates and paramedical staff

f. General acquaintance

- i. Fluorescent microscopy
- ii. Dark ground microscopy
- iii. Tissue culture
- iv. Microslide culture for fungus
- v. CD4 count estimation
- vi. Medical statistics
- vii. Quality control
- viii. Waste disposal
- ix. Molecular biology
- x. Information retrieval, computer, internet in medicine

4. Course content :

Post-graduate Examinations

The post-graduate examinations should be in 3 parts.

1. Thesis, to be submitted by each candidate at least 6 months before the date of commencement of the theory examination

2. Theory

There should be 4 theory papers

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

3. Practicals

Should be spread over 3 days and include the following components:

Bacteriology :

1. Identification of a pure culture
2. Isolation and Identification of Bacteria from Clinical Samples
3. Antibiotic susceptibility testing

Serology :

1. Common Serological Tests like ELISA / VDRL / Widal / Agglutination test etc.
2. TPHA etc. to include new tests
3. CIEP, agarose gel electrophoresis, immunoprecipitation

Virology:

1. Egg inoculation
2. Viral titration by haemagglutination (HA)
3. Complement fixation test
4. Haemagglutination inhibition (HAI), ELISA or any other serological test for diagnosis

Mycology :

1. Identification of fungal cultures

Parasitology:

1. Processing and Identification of ova and cysts in stool samples
2. Amoebic Serology
3. Serology for parasitic diseases

Animal experiments:

1. Collection of blood from laboratory animals
2. Inoculation of laboratory animals via various routes
3. Post mortem of laboratory animals

Spots:

Microscopic slides and gross specimens from virology, mycology, entomology and parasitology. These can also include clinical problems with x rays for interpretation of clinical problems.

Viva-voce including component of presentation of thesis done by the student

Course:

a. Knowledge

Paper I

General Microbiology

1. History of microbiology
2. Microscopy
3. Biosafety including universal containment
4. Physical and biological containment
5. Sterilization and disinfection
6. Morphology of bacteria and other microorganisms
7. Nomenclature and classification of microorganisms
8. Normal flora of human body
9. Growth & nutrition of bacteria
10. Bacterial metabolism
11. Bacterial toxins
12. Bacteriocins
13. Microbiology of hospital environment
14. Microbiology of air, milk and water
15. Host – parasite relationship
16. Antibacterial substances and drug resistance
17. Bacterial genetics & bacteriophages
18. Molecular genetics relevant of medical microbiology
19. Quality assurance & quality control in Microbiology
20. Accreditation of laboratories
21. Role of clinical microbiology in a hospital
22. Emerging infectious disease
23. Post exposure prophylaxis

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. Complements
8. Antigen & 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 & immunomodulation
22. Immunology of infectious disease

Paper II

Systematic bacteriology

1. Isolation & 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 & 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 & other non-fermenters, Pasteurella, Francisella, Bacterioides, Fusobacterium, Leptotrichia and other anaerobic gram negative bacilli etc.
6. Helicobacter, Campylobacter & Spirillum
7. Enterobacteriaceae
8. Mycobacteria
9. Spirochaetes
10. Chlamydiae
11. Mycoplasmatales, Mycoplasma, Ureaplasma, Acholeplasma and other Mycoplasmas
12. Rickettsia, Coxiella, Bartonella etc.

Mycology

1. General characteristics & classification of fungi
2. Morphology & 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, Pseudoallescheria, Fusarium, Piedra, other dematiaceous hyphomycetes and other hyalohyphomycetes etc.
7. Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffeii etc.
8. Dermatophytes
9. Fungi causing mycetoma, keratomycosis & otomycosis
10. Phythium insidiosum
11. Prototheca
12. Pneumocystis jirovecii infection
13. Rhinosporidium seeberi & Loboia Loboii
14. Actinomyces & Nocardia
15. Common laboratory contaminant fungi
16. Mycetismus & mycotoxicosis
Antifungal agents & invitro antifungal susceptibility tests.
17. Serological and molecular methods of diagnosis

Paper III

Virology

1. General properties of viruses
2. Classification of viruses
3. Morphology : Virus structure
4. Virus replication
5. Isolation & identification of viruses
6. Pathogenesis of viral infections
7. Genetics of viruses
8. DNA viruses of medical importance including Poxviridae, Herpesviridae, Adenoviridae, Hepadna virus, Papova and Parvo viruses etc.
9. RNA viruses of medical importance including Enteroviruses, Togaviridae, Flaviviruses, Orthomyxoviruses, Paramyxoviruses, Reoviridae, Rhabdoviridae, Arenaviridae, Bunyaviridae, Retroviridae, Filoviruses, Human immunodeficiency virus, Arboviruses, Coronaviridae, Calciviruses etc.
10. Slow viruses including prions
11. Unclassified viruses
12. Hepatitis viruses
13. Virioids
14. Vaccines, anti-viral drugs & antiviral testing
15. Oncogenic viruses
16. Newer emerging viruses

Parasitology

1. General characters & 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, Toenia, Echinococcus Hymenolepis, Dipylidium, Multiceps etc.), Trematoda (Schistosomes, Fasciola, Fasciolopsis, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis etc.) and Nematoda (Trichiuris, Trichinella, Strongyloids, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus etc.)
5. Entomology: Common arthropods & other vectors viz. mosquito, sandfly, ticks, mite, Cyclops, louse, myasis.
6. Antiparasitic agents
7. Antiparasitic susceptibility testing

Paper IV

Applied Microbiology

1. Epidemiology of infectious diseases
2. Hospital acquired infections
3. Management of hospital wastes
4. Investigation of an infectious outbreak including microbes that can be used for biological warfare (Bioterrorism)
5. 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 & nose, septicemia, hemorrhagic fever etc.
6. Opportunistic infections
7. Sexually transmitted diseases
8. Vaccinology : principle, methods of preparation, administration of vaccines
9. Information technology (Computers) in microbiology, Bioinformatics , research methodologies
10. Automation in Microbiology
11. Statistical analysis of microbiological data and research methodology
12. Animal and human ethics involved in microbiological work. Psychomotor Skills for postgraduate student in M.D. (Microbiology)
13. Applied molecular techniques in microbiology
14. Probiotics
15. National infectious disease control, eradication programmes
16. Recent advances in diagnostic techniques in clinical microbiology

17. Antimicrobial/ antiviral susceptibility testing

b. Skills (Practical):

1. Collection / transport of specimens for microbiological investigations
2. Preparation, examination & 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, capsules, spores, 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, Serum sugars, Kligler iron agar, Robertson's cooked meat broth, Lowenstein Jansens 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, distillation plant, filters like sietz and membrane filters
9. Care and operation of microscopes
10. Washing and sterilization of glassware (Plugging and packing)
11. Care and maintenance of common laboratory equipments like water bath, centrifuge, refrigerators, incubators etc.
12. Aseptic practices in Laboratory and safety precautions
13. Sterility tests
14. Identification of bacteria of medical importance upto species levels (except anaerobes which could be upto generic level).
15. Techniques of anaerobiosis
16. Tests of Motility : hanging drop, Cragie's tube, dark ground microscopy for spirochaetes
17. In-vitro toxigenicity test Elek test, Naegler's reaction
18. Special test-Bile solubility, chick cell agglutination, sheep cell haemolysis, niacin and catalase test for mycobacterium, satellitism, CAMP tests, catalase, slide & tube agglutination tests.
19. Preparation of antibiotic discs; performance of antimicrobial susceptibility testing. Kirby-Bauer, Stoke's method, Estimation of Minimal Inhibitory / Bactericidal concentrations by tube / plate dilution methods
20. Test for Beta-lactamase production
21. Inoculation of infective material by different routes in animals
22. Bleeding techniques of animals including sheep
23. Performance of autopsy on animals & disposal of animals
24. Animal pathogenicity / toxigenicity tests for *C. diphtheriae*, *C. tetani*, *S. pneumoniae*, *S. typhimurium*, *K. pneumoniae* etc.
25. Care and breeding of laboratory animals viz. mice, rats, guinea pigs, rabbits etc,
26. Testing of disinfectants – Phenol coefficients and “in use” tests.

27. Quantitative analysis of urine by pour plate method and semi quantitative analysis
28. Disposal of contaminated materials like cultures
29. Disposal, of infectious waste
30. Bacteriological tests for water, air and milk
31. Maintenance & preservation of bacterial cultures.
32. Various serological techniques used in clinical microbiology
33. Typing methods
34. Molecular techniques used in Microbiology: PCR, RFLP, Real time PCR
35. CD4 & CD8 count estimation, FACSCount machine
36. Automation system for identification of bacteria: Vitek, BACTEC

5. Evaluation:

a. Internal assessment (formative)

- This is presently not carried out in M.D. examinations. Hence it was suggested that parent institution submit grades for internal assessment based on log book and day to day assessment on yearly basis.

Grading as follows

- A: >75%
- B: 50-75%
- C: 25-49%
- D: < 25%
- Passed > 50%

b. University assessment (summative): As per MCI syllabus