MD MICROBIOLOGY CURRICULUM

AIIMS KALYANI

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ACADEMIC SECTION
AIIMS Kalyani

MICROBIOLOGY

Preamble

The main aim of this course is to train students of Medicine in the field of Clinical Microbiology who would provide high quality health care and advance the cause of science through research & training. Theoretical and practical training is imparted to the candidates in subspecialties viz., Bacteriology, Virology, Parasitology, Immunology& Serology, Mycology, Hospital Infection control and Molecular biology techniques so that they can participate in good patient care and can work independently in clinical microbiology laboratory. They are also trained in research methodology so that they can plan and conduct fundamental and applied research. They are also imparted training in teaching methods in the subject which may enable them to take up teaching assignments in medical colleges/institutes.

AIM & OBJECTIVE:

At the end of training, the microbiologist should be competent to:

- Perform microbiological laboratory diagnosis, suggest antimicrobial treatment, formulate local antimicrobial guidelines, design and implement antimicrobial stewardship policy.
- Manage diagnostic microbiology laboratory including quality management and accreditation.
- Guide and formulate infection control, biomedical waste management, clean and sterile supply department (CSSD), safe laboratory practice policies.
- Plan, execute and evaluate teaching assignments of Microbiology in medical college.
- Carry out applied and fundamental research in various branches of Microbiology involving other related disciplines for health care.
- Undergo specialization in any of the subspecialties in clinical microbiology.

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

- Laboratory and Diagnostic skills in Clinical Microbiology
- Teaching Skills
- Research Methodology
- Communication and attitudinal skills

TEACHING METHODS:

During a period of 3 years, intensive theoretical and practical training is imparted to the candidates as follows:

Cognitive/ Didactic lectures	One lecture (45 minutes followed by discussion of 15 minutes) of 1hr duration in alternate week
Problem based learning	One hour each for three sessions to cover one topic. PBL will alternate with alternate with didactic lecture every week
Seminar	One seminar (followed by discussion) of 1hr duration weekly
Journal club	One hr (including discussion) weekly. Two speakers, a Faculty Member or a Senior Resident and a Junior Resident present articles of recent journals
Tutorial/group discussion/review club	One of 1hr duration weekly
Clinico-pathological conference (CPC):	Residents attend interdepartmental CPC twice in a week Joint symposium: one (one hr and a half including discussion) every three months where three Junior Residents make presentations on different aspects of a defined clinical problem
Course on Research Methodology and Biostatistics	Each Junior resident has to attend the course and clear a written examination at the end of the course.
Molecular technique course	A month-long posting to learn nucleic acid and protein profiling techniques/nucleic acid sequencing techniques/bioinformatics/ advanced typing method for the diagnosis and typing of microbes.

Presentation (teaching) skills:

Seminar:

- Junior Residents present seminars under the moderation of a Faculty Member.
- In three years each Junior Resident presents a minimum of 6 seminars (preferably one seminar each in the following subspecialties, viz bacteriology, serology, mycology, parasitology, HICC, molecular biology, mycobacteriology and virology)

Journal club:

- Junior Residents must present at least 6 journal clubs in 3 years

Joint symposium:

One (one hour and a half including discussion) every three months where three Junior Residents make presentations on different aspects of a defined clinical problem under the guidance of a Faculty Member.

- A Junior Resident takes active part in a minimum of five symposium in three-year tenure.

Teaching assignment

- A Junior Resident takes lectures and demonstrations for BSc, Medical Laboratory Technology (MLT), BSc (Nursing) and BSc (Physiotherapy) courses.
- They must also be involved in practical demonstrations for MBBS students.

Practical training:

- A Junior Resident is posted to work in rotation in various subspecialties viz bacteriology, serology, mycology, parasitology, HICC, molecular biology, mycobacteriology and virology and shall also actively participate in routine diagnostic and research activities of the laboratories daily during the working hours
- They are also put on Emergency Microbiology duties to train them in taking independent decisions while reporting on the specimens received in emergency laboratory.
- As a part of practical training the PG trainee also takes part in antimicrobial/antifungal stewardship WARD and ICU rounds on a regular basis with the faculty.
- During the practical training a PG trainee carries out the practical exercises relevant to the section as per syllabus, takes active part in routine diagnostic services and has daily bench-side discussions on the topics with Members of the Faculty.

Thesis:

Junior Resident conducts research on a problem relevant to medical microbiology under the guidance of Faculty Members and submits a protocol at the end of the 6 months and the final thesis at the end of 2 year.

ASSESSMENT :

Formative:

- The day-to-day performance of the candidate is judged by the Faculty Members under whose

supervision the student had worked in a laboratory.

- The seminars/ Journal clubs presented by the candidate are also evaluated by all faculty members
- Formal written test and viva voce examination is conducted at the end of each posting (100 marks each). Members of the Faculty (minimum of two) conduct the examination and the performance assessment is shown to the candidate.
- The marks obtained in the internal assessment examination in addition to the score obtained in the final MD examination are considered for awarding of medal of all-round excellence in the final MD exam.
- The candidate shall maintain a log book, duly formulated and filled in, should be submitted for scrutiny and completion of the academic criteria.

Summative:

Theory Examination: Each paper-3hours (100 marks each)

MD Microbiology theory examination format	
Paper 1	General Microbiology and Immunology
Paper 2	Systematic Bacteriology and Mycology
Paper 3	Virology and Parasitology
Paper 4	Applied microbiology and recent advances

Practical Examination: Marks: 600 / Duration: two days
The examination will consist of the following exercises conjointly conducted and evaluated by four examiners, two internals and two externals.

MD Microbiology practical examination format	
Clinical Bacteriology	Isolation and identification of bacteria from clinical specimen, susceptibility testing
Virology	Serological tests / Molecular tests / conventional virology techniques
Mycology	Identification of fungal cultures
Parasitology	Examination of stool for ova and cysts by direct and concentration techniques Examination of peripheral blood smears / bone marrow for parasites Animal inoculation exercise – depending upon availability
Immunology	Any one of the serological techniques used in clinical medicine
Spotting exercises	Histopathological sections/ smears showing bacteria, fungi, parasites, viruses

	Equipment and materials used in diagnostic research microbiology laboratory Direct smears and Clinical charts
Pedagogy	
OSCE (Objective structured clinical examination)	
Oral examination/ Grand viva	Questioning on the dissertation and overall subject matter. It will be conducted by all the four examiners as in the case of the practical examination

Computation of marks:

- 400 Theory (Pass marks 50%)
- 600 Practical and viva voce (Pass marks 50%)

- 1000 Aggregate (Pass marks 50%)

COURSE CONTENT (SYLLABUS):

General Microbiology

- History and pioneers in Microbiology
- Microscopy
- Bio-safety including standard precautions
- Morphology of bacteria and other microorganisms
- Nomenclature and classification of microbes
- Growth and nutrition of bacteria
- Bacterial metabolism
- Sterilization and disinfection
- Bacterial toxins
- Bacterial antagonism: Bacteriocins
- Bacterial genetics and bacteriophages
- Antibacterial substances used in the treatment of infections and drug resistance in bacteria
- Bacterial ecology - Normal flora of the human body
- Hospital environment
- Air, water and milk
- Host parasite relationship
- Quality control and accreditation in Microbiology
- Immunology
- The immune system
- Innate and acquired immunity
- Cells involved in immune response
- Antigens
- Immunoglobulins
- Complement
- Antigen and antibody reactions

- Hypersensitivity
- Cell mediated immunity
- Immunodeficiency
- Autoimmunity
- Immune tolerance
- Transplantation immunity
- Tumor immunity
- Prophylaxis and immunotherapy
- Measurement of immunity
- Immunological techniques

Systematic Bacteriology

- Isolation, description and identification of bacteria
- Gram positive cocci of medical importance including Staphylococcus, Micrococcus, Streptococcus, anaerobic cocci, etc.
- Gram negative cocci of medical importance including Neisseria, Moraxella, etc.
- 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.
- Gram negative bacilli of medical importance including Enterobacterials, Vibrio, Aeromonas, Pleisiomonas, Haemophilus, Bordetella, Brucella, Gardnerella, Pseudomonas & other non-fermenters, Pasturella, Francisella, Bacteroides, Fusobacterium, Leptotrichia, and other anaerobic Gram negative bacilli, etc.
- Helicobacter, Campylobacter and Spirillium
- Mycobacteria
- The Spirochaetes
- Chlamydiae
- Rickettsia, Coxiella, Bartonella
- Mycoplasmatales: Mycoplasma, Ureaplasma, Acholeplasma
- Miscellaneous bacteria

Virology:

- The nature of viruses
- Classification of viruses
- Morphology: virus structure
- Virus replication
- The genetics of viruses
- The pathogenicity of viruses
- Epidemiology of viral infections
- Laboratory diagnosis of viral infections
- Vaccines and anti-viral drugs
- Bacteriophages
- RNA viruses of medical importance including, Enteroviruses, Togaviridae, Flaviviruses, Orthomyxoviruses, Paramyxoviruses, Reoviridae, Rhabdoviridae, Arenaviridae, Bunyaviridae, Retroviridae, Filoviruses, Human immunodeficiency virus, Arboviruses, Coronaviridae, Calciviruses,

etc.
- DNA viruses of medical importance including Poxviridae, Herpessviridae, Adenoviridae, Hepadnavirus, Papova and Parvoviruses, etc.
- Slow viruses and Prions
- Human immunodeficiency viruses
- Oncogenic viruses
- Viruses of gastroenteritis
- Miscellaneous and Emerging viruses
- Viroids

Parasitology:

- General characteristics and classification of parasites
- Pathogenesis and pathology of parasitic infections.
- Protozoan parasites of medical importance including Entamoeba, Giardia, Balantidium coli, Trichomonas, intestinal coccidian parasites, Toxoplasma, Sarcocystis, blood parasites including Plasmodium, Leishmania, Trypanosoma.
- Cestodes and Trematodes of medical importance including, Diphyllobothrium latum, Spirometra, Taenia, Echinococcus, Hymenolepis, Dipylidium caninum, Schistosoma, Fasciola, Fasciolopsis buski, Paragonimus, Clonorchis, other trematodes.
- Nematodes of medical importance including, nematodes such as Trichuris, Trichinella, Capillaria, Strongyloides, Ancylostoma, Necator, Enterobius, Ascaris, Toxocara, agents causing larva migrans, tissue nematodes including, Filarial worms, Dracunculus medinensis.
- Ectoparasites: Common arthropods and other vectors viz. Mosquito, Sandfly, Ticks, Mite, Cyclops
- Laboratory methods in medical Parasitology
- Antiparasitic agents
- Immunity in parasitic infections

Mycology:

- The morphology and reproduction of fungi
- Classification of fungi
- Contaminant and opportunistic fungi including Candida, Cryptococcus, Pneumocystis, Aspergillus, Zygomycetes, Penicillium marneffei.
- Superficial mycotic fungi including Dermatophytes.
- Fungi causing subcutaneous mycoses including mycetoma and rhinosporidiosis.
- Fungi causing systemic infections including Histoplasma,Blastomyces,Coccidioides, Paracoccidioides, Sporothrix.
- Keratomycosis and otomycosis.
- Fungal toxicosis.
- Laboratory methods in Mycology including serological and molecular diagnostic methods
- Antifungal agents and in-vitro antifungal susceptibility testing.

Applied microbiology and recent advances:
- Epidemiology of infectious diseases
- Hospital acquired infections
- Hospital waste management

- Molecular genetics as applicable to Microbiology
- Vaccinology: principle, methods of preparation, administration of vaccines
- Investigation of an infectious outbreak including infections of various organs and systems of human body viz. sexually transmitted diseases, 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, sepitcaemia, endocarditis, haemorrhagic fever, etc.
- Emerging and re-emerging infections.
- Automation in microbiology.
- Statistical analysis of microbiological data and research methodology.
- Knowledge about care & handling of animals and routes of inoculation

Skills for Postgraduate students in MD Microbiology:

A. Bacteriology-

a. Must Acquire

- Care and operation of microscopes viz. light, dark ground, phase contrast and fluorescence microscopes
- Preparation and pouring of media-nutrient agar, blood agar, MacConkey agar, sugars, serum sugars, Kligler Iron agar, Robertson‘s cooked meat, Lowenstein- Jensen‘s, Sabouraud's dextrose
- Operation of autoclave, hot air oven, distillation plant, filters like Seitz and membrane and sterility tests
- Washing and sterilization of glass wares (plugging and packing)
- Preparation of reagents-oxidase, Kovac's, etc
- Disposal of contaminated materials like cultures
- Testing of disinfectants
- Quality control of media, reagents, etc.
- Aseptic practices in laboratory and safety precautions
- Care and maintenance of common laboratory equipment like water bath, centrifuge, refrigerator, incubator, thermocycler, automated Identification.
- Antimicrobial susceptibility testing and blood culture system, microcentrifuge, ELISA system etc.
- Preparation of antibiotic discs: performance antibiotic sensitivity tests by Kirby Bauer, Stokes method, etc. Estimation of minimal inhibitory/bactericidal concentration by tube/plate dilution methods
- Tests for β-lactamases, ESBL, AmpC, Metallobetalactamases
- Collection of specimens for microbiological investigations on blood, urine, throat swab, rectal swab, stool, pus (swabs), OT specimens
- Identification of bacteria of medical importance up to species level (except anaerobes which could be up to generic level)
- Techniques of anaerobiosis, anaerobic jars, evacuation and filling with CO2 and H2, automated anaerobic system.
- Preparation of stains viz. Grams, Albert, capsule, spores, Ziehl-Neelsen etc. and performance of staining
- Preparation, examination and interpretation of direct smears from clinical specimens viz.

sputum for AFB-ZN, auramine O, slit smears for M. leprae for ZN staining, conjunctival smears for Chlamydia by Giemsa/Iodine

- Quantitative analysis of urine by pour plate method and semiquantitative analysis by standard loop test for finding significant bacteriuria
- Plating of clinical specimens on media for isolation, purification, identification and quantification purposes
- Tests for motility: hanging drop, Craigie's tube
- In-vitro toxicity tests-Elek's test, Nagler‘s reaction
- Special tests-bile solubility, chick cell agglutination, sheep cell haemolysis, niacin and catalase tests for Mycobacterium, satellitism, CAMP test, catalase, slide agglutination tests
- Bacteriological test for air, water and milk.
- Maintenance and preservation of bacterial cultures.

b. Desirable to acquire

- Conjugation experiments for drug resistance
- Serum antimicrobials therapeutic drug monitoring assays
- Serological grouping of Streptococcus
- Antibiotic susceptibility tests for Mycobacteria
- Molecular typing methods
- Special staining techniques for Mycoplasma, Treponemes, Gardenerella

B. Immunology-

a. Must acquire

- Collection of blood by venepuncture, separation of serum and preservation of serum for short and long periods
- Performance of serological tests viz. Widal, Brucella tube agglutination, Weil- Felix, Cold agglutination, VDRL, ASO
- Enzyme linked immunosorbent assay (ELISA)
- Western blot
- Immunoassays like Chemiluminescence(CLIA), Flourescence (ELFA)
- Latex and Staphylococcal Co-agglutination tests

b. Desirable to acquire

- Preparation of antigens from bacteria or tissues like Widal, Weil-Felix, VDRL, etc and their standardization
- Raising of antisera in laboratory animals

C. Mycology-

a. Must acquire

- Collection and transport of specimens
- Direct examination of specimens by KOH, Gram's, Kinyoun's, Giemsa, Lactophenol cotton blue stains
- Calcofluor staining and examination under fluorescent microscope.
- Examination of histopathology slides for fungal infections
- Isolation and identification of common laboratory contaminants, dermatophytes and

others of medical importance (yeast, dematiaceous fungi)
- Special techniques like Wood's lamp examination, hair baiting, hair perforation, paraffin baiting and slide culture
- Maintenance of stock cultures
- Antigen and antibody based serological test in fungal diseases including Candida, Cryptococcosis, Aspergillus, etc.

D. Parasitology-

a. Must Acquire

- Examination of feces for parasitic ova and cysts etc. by direct and concentration methods (salt floatation and formal-ether methods)
- Examination of blood for protozoa and helminthes by wet mount and thin and thick stained smears
- Examination of other specimens e.g. urine, CSF, bone marrow etc. for parasites
- Histopathology sections-examination and identification of parasites
- Performance of stains- Leishman, Giemsa
- In-vitro culture of parasites like Entamoeba, Leishmania, etc.
- Preparation of media-NIH, NNN, etc.
- Antigen preparation-viz. Entamoeba, filarial, hydatid for serological tests like IHA and skin tests like Casoni's test
- Identification of common arthropods and other vectors viz., mosquito, sandfly, tick, mite, Cyclops
- Collection of specimens
- Preservation of parasites- mounting, fixing, staining, etc.
- QBC for malaria.

b. Desirable to Acquire

- Permanent staining techniques like iron haematoxylin
- Antigen based and antibody based serological diagnostic tests such as ELISA, Western blot, etc for cysticercosis, amoebiasis, hydatid disease, filariasis, etc.

E. Virology-

a. Must acquire

- Serological tests-ELISA for HIV, HBsAg, HCV, Hepatitis virus, arboviruses etc.
- Molecular assays for the detection of various viruses.
    - Virology - Desirable to acquire
- Preparation of glass wares for tissue cultures (washing, sterilization)
- Preparation of media like Hanks, MEM
- Preparation of clinical specimens for isolation of viruses
- Maintenance of continuous cell lines by subcultures. Preservation in -70ºC and liquid nitrogen
- Recognition of CPE producing viruses
- Performance of haemadsorption for Parainfluenza, Haemagglutination for Influenza, Immunofluorescence, neutralization for Enteroviruses and Respiratory viruses, identification tests on tissue cultures and supernatants, etc.

F. Molecular biology-

a. Must acquire

- Extraction of DNA, RNA
- Estimation of quality and quantity of Nucleic acids
- Conventional and real time PCR

b. -Desirable to acquire

- Sequencing (Sanger / Next generation sequencing)

Recommended Textbooks

- Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases
- Topley and Wilsons Microbiology and Microbial infections
- Manual of Clinical Microbiology: 2 Volume Set (ASM Books)
- Clinical Microbiology Procedures Handbook, 3 Volume Set, 4th Edition
- Plotkin's Vaccines
- Fields' virology
- Bailey and Scott's Diagnostic Microbiology
- Koneman's Atlas and Textbook of Diagnostic Microbiology
- Cellular and Molecular Immunology – Abbas, Lichtman, Pillai
- Kuby Immunology
- Essentials of clinical mycology. New York: Springer
- Jopling's Handbook of Leprosy
- Schlossberg Tuberculosis and Nontuberculous mycobacterial infections
- Anthony Fooks, Allan Jackson – Rabies – Scientific basis of the disease and its management
- Garcia - Practical Guide to Diagnostic Parasitology
- Manson's Tropical Diseases

Kucers' The Use of Antibiotics: A Clinical Review of Antibacterial, Antifungal, Antiparasitic,