MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

Syllabus

MD – MICROBIOLOGY

(3 Years Post Graduate Degree Course)

Notice

1. Amendment made by the Medical Council of India in Rules/Regulations of Post Graduate Medical Courses shall automatically apply to the Rules/Regulations of the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST), Jaipur.

2. The University reserves the right to make changes in the syllabus/books/guidelines, fees-structure or any other information at any time without prior notice. The decision of the University shall be binding on all.

3. The Jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

RULES & REGULATIONS
MD MICROBIOLOGY (9110)
(3 Years Post Graduate degree course)

TITLE OF THE COURSE:
It shall be called Doctor of Medicine.

ELIGIBILITY FOR ADMISSION:
No candidate of any category (including NRI quota) shall be eligible for admission to MD/MS courses, if he or she has not qualified NEET PG (MD/MS) conducted by National Board of Examinations or any other Authority appointed by the Government of India for the purpose.

(1) **General Seats**

(a) Every student, selected for admission to postgraduate medical course shall possess recognized MBBS degree or equivalent qualification and should have obtained permanent Registration with the Medical Council of India, or any of the State Medical Councils or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled;

(b) Completed satisfactorily one year's rotatory internship or would be completing the same before the date announced by the University for that specific year as per MCI rules after passing 3rd professional MBBS Part II Examination satisfactorily.

(c) In the case of a foreign national, the Medical Council of India may, on payment of the prescribed fee for registration, grant temporary registration for the duration of the postgraduate training restricted to the medical college/institution to which he/she is admitted for the time being exclusively for postgraduate studies; however temporary registration to such foreign national shall be subject to the condition that such person is duly registered as medical practitioner in his/her own country from which he has obtained his basic medical qualification and that his degree is recognized by the corresponding Medical Council or concerned authority.

(2) **NRI Seats**

(a) Students from other countries should possess passport, visa and exchange permits valid for the period of their course of study in this Institution and should also observe the regulations of both central and state governments regarding residential permits and obtain no-objection certificate from the same.

(b) The candidate should have a provisional "Student Visa". If he comes on any other visa and is selected for admission, he will have to first obtain a student visa from his country and then only he will be allowed to join the course. Therefore it is imperative to obtain provisional student visa before coming for Counseling.

(c) This clause is applicable to NRI/Foreign Students only.

CRITERIA FOR SELECTION FOR ADMISSION:

(1) **NRI Quota**

15% of the total seats are earmarked for Foreign National / PIO / OCI/ NRI / Ward of NRI/NRI sponsored candidates who would be admitted on the basis of merit obtained in NEET PG or any other criteria laid down by Central Government/MCI.

(2) **Remaining Seats (Other than NRI Quota Seats)**

(a) Admissions to the remaining 85% of the seats shall be made on the basis of the merit obtained at the NEET conducted by the National Board of Examinations or any other Authority appointed by the Government of India for the purpose.
(b) The admission policy may be changed according to the law prevailing at the time of admission.

COUNSELING/INTERVIEW:

(1) Candidates in order of merit will be called for Counseling/Interview and for verification of original documents and identity by personal appearance.
(2) Counseling will be performed and the placement will be done on merit-cum-choice basis by the Admission Board appointed by the Government of Rajasthan.

RESERVATION:

Reservation shall be applicable as per policy of the State Government in terms of scheduled caste, scheduled tribe, back ward class, special back ward class, women and handicapped persons.

ELIGIBILITY AND ENROLMENT:

Every candidate who is admitted to MD/MS course in Mahatma Gandhi Medical College & Hospital shall be required to get himself/herself enrolled and registered with the Mahatma Gandhi University of Medical Sciences & Technology after paying the prescribed eligibility and enrolment fees.

The candidate shall have to submit an application to the MGUMST for the enrolment/eligibility along with the following original documents with the prescribed fees (upto November 30 of the year of admission without late fees and upto December 31 of the year of admission with late fees) –

(a) MBBS pass Marks sheet/Degree certificate issued by the University (Ist MBBS to Final MBBS)
(b) Certificate regarding the recognition of medical college by the Medical Council of India.
(c) Completion of the Rotatory Internship certificate from a recognized college.
(d) Migration certificate issued by the concerned University.
(e) Date of Birth Certificate
(f) Certificate regarding registration with Rajasthan Medical Council / Medical Council of India / Other State Medical Council.

REGISTRATION

Every candidate who is admitted to MD/MS course in Mahatma Gandhi Medical College & Hospital shall be required to get himself/herself registered with the Mahatma Gandhi University of Medical Sciences & Technology after paying the prescribed registration fees.

The candidate shall have to submit an application to the MGUMST for registration with the prescribed fees (upto November 30 of the year of admission without late fees upto December 31 of the year of admission with late fees).

DURATION OF COURSE:

The course shall be of 3 years duration from the date of commencement of academic session.

PERIOD OF TRAINING:

The period of training for obtaining Post graduate degrees (MD/MS) shall be three completed years including the period of examination.

MIGRATION:

No application for migration to other Medical Colleges will be entertained from the students already admitted to the MD/MS course at this Institute.

METHODS OF TRAINING FOR MD/MS:

Method of training for MD/MS courses shall be as laid down by the Medical Council of India.

ONLINE COURSE IN RESEARCH METHODS

i. All postgraduate students shall complete an online course in Research Methods to be conducted by an Institute(s) that may be designated by the Medical Council of India by way of public notice, including on its website and by Circular to all Medical Colleges. The students shall have to register on the portal of the designated institution or any other institute as indicated in the public notice.
ii. The students have to complete the course by the end of their 2nd semester.
iii. The online certificate generated on successful completion of the course and examination thereafter, will be taken as proof of completion of this course
iv. The successful completion of the online research methods course with proof of its completion shall be essential before the candidate is allowed to appear for the final examination of the respective postgraduate course.
v. This requirement will be applicable for all postgraduate students admitted from the academic year 2019-20 onwards

ATTENDANCE, PROGRESS AND CONDUCT:

(1) **Attendance:**

(a) 80% attendance in each course is compulsory. Any one failing to achieve this, shall not be allowed to appear in the University examination.
(b) A candidate pursuing MD/MS course shall reside in the campus and work in the respective department of the institution for the full period as a full time student. No candidate is permitted to run a clinic/work in clinic/laboratory/ nursing home while studying postgraduate course. No candidate shall join any other course of study or appear for any other examination conducted by this university or any other university in India or abroad during the period of registration. Each year shall be taken as a unit for the purpose of calculating attendance.
(c) Every candidate shall attend symposia, seminars, conferences, journal review meetings, grand rounds, CPC, CCR, case presentation, clinics and lectures during each year as prescribed by the department and not absent himself / herself from work without valid reasons. Candidates should not be absent continuously as the course is a full time one.

(2) **Monitoring Progress of Studies- Work diary/Log Book:**

(a) Every candidate shall maintain a work diary in which his/her participation in the entire training program conducted by the department such as reviews, seminars, etc. has to be chronologically entered.
(b) The work scrutinized and certified by the Head of the Department and Head of the Institution is to be presented in the University practical/clinical examination.

(3) **Periodic tests:**

There shall be periodic tests as prescribed by the Medical Council of India and/ or the Board of Management of the University, tests shall include written papers, practical/clinical and viva voce.

(4) **Records:**

Records and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University when called for.

THESIS:

(1) Every candidate pursuing MD/MS degree course is required to carry out work on research project under the guidance of a recognized post graduate teacher. Then such a work shall be submitted in the form of a Thesis.
(2) The Thesis is aimed to train a postgraduate student in research methods & techniques.
(3) It includes identification of a problem, formulation of a hypothesis, designing of a study, getting acquainted with recent advances, review of literature, collection of data, critical analysis, comparison of results and drawing conclusions.
(4) Every candidate shall submit to the Registrar of the University in the prescribed format a Plan of Thesis containing particulars of proposed Thesis work within six months of the date of commencement of the course on or before the dates notified by the University.
(5) The Plan of Thesis shall be sent through proper channel.
(6) Thesis topic and plan shall be approved by the Institutional Ethics Committee before sending the same to the University for registration.
(7) Synopsis will be reviewed and the Thesis topic will be registered by the University.
(8) No change in the thesis topic or guide shall be made without prior notice and permission from the University.
(9) The Guide, Head of the Department and head of the institution shall certify the thesis. Three printed copies and one soft copy of the thesis thus prepared shall be submitted by the candidate to the Principal. While retaining the soft copy in his office, the Principal shall send the three printed copies of the thesis to the Registrar six months before MD/MS University Examinations. Examiners appointed by the University shall evaluate the thesis. Approval of Thesis at least by two examiners is an essential pre-condition for a candidate to appear in the University Examination.
(10) Guide: The academic qualification and teaching experience required for recognition by this University as a guide for thesis work is as laid down by Medical Council of India/Mahatma Gandhi University of Medical Sciences & Technology, Jaipur.
(11) Co-guide: A co-guide may be included provided the work requires substantial contribution from a sister department or from another institution recognized for teaching/training by Mahatma Gandhi University of Medical Sciences & Technology, Jaipur/Medical Council of India. The co-guide shall be a recognized postgraduate teacher.
(12) Change of guide: In the event of a registered guide leaving the college for any reason or in the event of death of guide, guide may be changed with prior permission from the University.

ELIGIBILITY TO APPEAR FOR UNIVERSITY EXAMINATION:

The following requirements shall be fulfilled by every candidate to become eligible to appear for the final examination:

(1) Attendance: Every candidate shall have fulfilled the requirement of 80% attendance prescribed by the University during each academic year of the postgraduate course. (as per MCI rules)
(2) Progress and Conduct: Every candidate shall have participated in seminars, journal review meetings, symposia, conferences, case presentations, clinics and didactic lectures during each year as designed by the department.
(3) Work diary and Logbook: Every candidate shall maintain a work diary for recording his/her participation in the training program conducted in the department. The work diary and logbook shall be verified and certified by the Department Head and Head of the Institution.

(4) Every student would be required to present one poster presentation, to read one paper at a National/State Conference and to have one research paper which should be published/accepted for publication/ sent for publication to an indexed journal during the period of his/her post graduate studies so as to make him/her eligible to appear at the Post Graduate Degree Examination.
(5) Every student would be required to appear in and qualify the Pre-University Post graduate degree Mock examination. Post graduate students who fail to appear in or do not qualify the Pre-University Post graduate degree Mock examination shall not be permitted to appear in the final examination of the University.

The certification of satisfactory progress by the Head of the Department/ Institution shall be based on (1), (2), (3), (4) and (5) criteria mentioned above.

ASSESSMENT:

(1) The progress of work of the candidates shall be assessed periodically by the respective guides and report submitted to the Head of the Institution through the Head of the Department at the end of every six months. The assessment report may also be conveyed in writing to the candidate who may also be advised of his/her shortcomings, if any.
(2) In case the report indicate that a candidate is incapable of continuing to do the work of the desired standard and complete it within the prescribed period, the Head of the Institution may recommend cancellation of his/her registration at any time to the University.
(3) Formative Assessment:
    (a) General Principles
        i. The assessment is valid, objective, constructive and reliable.
        ii. It covers cognitive, psychomotor and affective domains.
        iii. Formative, continuing and summative (final) assessment is also conducted.
        iv. Thesis is also assessed separately.
    (b) Internal Assessment
        i. The internal assessment is continuous as well as periodical. The former is based on the feedback from the senior residents and the consultants concerned. Assessment is held periodically.
        ii. Internal assessment will not count towards pass/fail at the end of the program, but will provide feedback to the candidate.
        iii. The performance of the Postgraduate student during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student.
        iv. Marks should be allotted out of 100 as under
            1) Personal Attributes - 20 marks
                a. Behavior and Emotional Stability: Dependable, disciplined, dedicated, stable in emergency situations, shows positive approach.
                b. Motivation and Initiative: Takes on responsibility, innovative, enterprising, does not shirk duties or leave any work pending.
                c. Honesty and Integrity: Truthful, admits mistakes, does not cook up information, has ethical conduct, exhibits good moral values, loyal to the institution.
            2) Clinical Work - 20 marks
                a Availability: Punctual, available continuously on duty, responds promptly on calls and takes proper permission for leave.

b Diligence: Dedicated, hardworking, does not shirk duties, leaves no work pending, does not sit idle, competent in clinical case work up and management.

c Academic Ability: Intelligent, shows sound knowledge and skills, participates adequately in academic activities and performs well in oral presentation and departmental tests.

d Clinical Performance: Proficient in clinical presentations and case discussion during rounds and OPD work up. Preparing Documents of the case history/examination and progress notes in the file (daily notes, round discussion, investigations and management) Skill of performing bed side procedures and handling emergencies.

3) Academic Activities - 20 marks
Performance during presentation at Journal club/ Seminar/Case discussion/Stat meeting and other academic sessions. Proficiency in skills as mentioned in job responsibilities.

4) End of term theory examination - 20 marks
End of term theory examination conducted at end of 1st, 2nd year and after 2 years 9 months.

5) End of term practical examination - 20 marks
   a. End of term practical/oral examinations after 2 years 9 months.
   b. Marks for personal attributes and clinical work should be given annually by all the consultants under whom the resident was posted during the year. Average of the three years should be put as the final marks out of 20.
   c. Marks for academic activity should be given by the all consultants who have attended the session presented by the resident.
   d. The Internal assessment should be presented to the Board of examiners for due consideration at the time of Final Examinations.
   e. Yearly (end of 1st, 2nd & 3rd year) theory and practical examination will be conducted by internal examiners and each candidate will enter details of theory paper, cases allotted (2 long & 2 short) and viva.
   f. Log book to be brought at the time of final practical examination.

APPOINTMENT OF EXAMINERS:

Appointment of paper setters, thesis evaluators, answer books evaluators and practical & viva voce examiners shall be made as per regulations of the Medical Council of India.

SCHEME OF EXAMINATION:

Scheme of examination in respect of all the subjects of MD/MS shall be as under :

(1) The examination for MD/MS shall be held at the end of three Academic Years.
(2) Examinations shall be organized on the basis of marking system.
(3) The period of training for obtaining MD/MS degrees shall be three completed years including the period of examination.
(4) The University shall conduct not more than two examinations in a year for any subject with an interval of not less than 4 months and not more than 6 months between the two examinations.
(5) The examinations shall consist of:
   (a) Thesis :
      i. Thesis shall be submitted at least six months before the main Theory examinations.

ii. 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/Practical.
iii. In departments where besides the two earmarked practical/clinical examiners no one else is a qualified P.G. teacher, in that case the Thesis shall be sent to the third external examiner who shall actually be in place of the internal examiner.
iv. Only on the acceptance of the thesis by any two examiners, the candidate shall be eligible to appear for the final examination.
v. A candidate whose thesis has been once approved by the examiners will not be required to submit the Thesis afresh, even if he/she fails in theory and/or practical of the examination of the same branch.
vi. In case the Thesis submitted by a candidate is rejected, he/she should be required to submit a fresh Thesis.

(b) Theory papers:
i. There shall be four theory papers.
ii. Each theory paper examination shall be of three hours duration.
iii. Each theory paper shall carry maximum 100 marks.
iv. The question papers shall be set by the External Examiners.
v. There will be a set pattern of question papers.
Every question paper shall contain three questions. All the questions shall be compulsory, having no choice.
Question No. 1 shall be of long answer type carrying 20 marks.
Question No. 2 shall have two parts of 15 marks each. Each part will be required to be answered in detail.
Question No. 3 shall be of five short notes carrying 10 marks each.

vi. The answer books of theory paper examination shall be evaluated by two External and two internal examiners. Out of the four paper setters, the two paper setters will be given answer books pertaining to their papers and the answer books of the remaining two papers will be evaluated by two Internal Examiners. It will be decided by the President as to which paper is to be assigned to which Internal Examiner for evaluation.
vii. A candidate will be required to pass theory and practical examinations separately in terms of the governing provisions pertaining to the scheme of examination in the post graduate regulations. The examinee should obtain minimum 40% marks in each theory paper and not less than 50% marks cumulatively in all the four papers for degree examination to be cleared as "passed" at the said Degree examination.

(c) Clinical/ Practical & Oral examinations:
i. Clinical/Practical and Oral Examination of 400 marks will be conducted by at least four examiners, out of which two (50%) shall be External Examiners.
ii. A candidate will be required to secure at least 50% (viz. 200/400) marks in the Practical including clinical and viva voce examinations.

(6) If a candidate fails in one or more theory paper(s) or practical, he/she shall have to reappear in the whole examination i.e. in all theory papers as well as practical.

GRACE MARKS

No grace marks will be provided in MD/MS examinations.

REVALUATION / SCRUTINY:

No Revaluation shall be permitted in the MD/MS examinations. However, the student can apply for scrutiny of the answer books as per University Rules.

GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN MICROBIOLOGY (9110)

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".

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

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

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

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

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

Based on the available facilities, the department should prepare a list of Post Graduate experiments pertaining to basic, diagnostic and applied Microbiology. Active learning should form the mainstay of the postgraduate training. There should be lectures 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

- Important historical events and developments in microbiology
- Basic as well as advanced knowledge in various microscopes and microscopic techniques used in diagnostic microbiology
- Various bio-safety issues including physical and biological containment, universal containment, personal protective equipment for biological agents
- Various isolation precautions including standard and transmission based precautions
- In-depth knowledge about various method of Sterilization, disinfection and lyophilization
- Nomenclature, classification and morphology of bacteria as well as other microorganisms
- Various types and significance of normal flora of human body in health and disease states.
- Requirements for growth and nutrition of bacteria along with bacterial metabolism
- Various types and role of bacterial toxins and bacteriocins
- Microbiology of air, milk, water as well as hospital environment
- Various types of host-parasite relationship and their significance
- Various antimicrobial agents and mechanisms drug resistance
- Bacterial genetics, bacteriophages and molecular genetics relevant for medical microbiology

- Applications of quality assurance, quality control in microbiology and accreditation of laboratories

Immunology

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

Systematic bacteriology

- Demonstrate knowledge and skills in various techniques for isolation and identification of bacteria
- 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-
    - Gram positive cocci including Staphylococcus, Micrococcus, Streptococcus, anaerobic cocci etc.
    - Gram negative cocci including Neisseria, Branhamella, Moraxella etc.
    - 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.
    - 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.
    - Helicobacter, Campylobacter, Calymmatobacterium, Streptobacillus, Spirillum and miscellaneous bacteria
    - Enterobacteriaceae
    - Mycobacteria
    - Spirochaetes
    - Chlamydia
    - Mycoplasmatales; Mycoplasma, Ureaplasma, Acholeplasma and other Mycoplasmas.
    - Rickettsiae, Coxiella, Bartonella etc.

Mycology

- Explain general characteristics including morphology, reproduction and classification of fungi
- Demonstrate knowledge and skills for isolation and identification of fungi
- Explain tissue reactions to fungi

- 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-
  - Yeasts and yeast like fungi including Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces etc.
  - Mycelial fungi including Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra, other dematiaceous hyphomycetes and other hyalohyphomycetes etc.
  - Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffei etc.
  - Dermatophytes
  - Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis and Otomycosis.
  - Pneumocystis jirovecii infection
  - Rhinosporidium seeberi and Lacazia loboi (formerly named Loboa loboi) Pythium insidiosum
  - Prototheca
- Able to identify laboratory contaminant fungi
- Explain Mycetismand mycotoxicosis along with agents involved
- Demonstrates knowledge about antifungal agents and perform in vitroantifungal susceptibility tests.

Virology

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

Parasitology

- Demonstrate knowledge about general characters, classification and methods of identification of parasites.
- Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of Protozoan parasites of medical importance including Entamoeba, Free living amoebae, Giardia,

Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma, Sarcocystis, Cryptosporidium, Microsporidium, Cyclospora Isospora, Babesia, Balantidium, etc.

- 3.Demonstrate knowledge about epidemiology, morphology, antigenic nature, life cycle, pathogenesis, complications, laboratory diagnosis, treatment and prevention of helminthes of medical importance including those belonging to Cestoda (Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipyllidium, Multicepsetc.), Trematoda (Schistosomes, Fasciola, Fasciolopsis, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis etc.) and Nematoda (Trichiuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus etc.)
- Demonstrate knowledge about common arthropods and other vectors viz. mosquito, sand fly, ticks, mite, cyclops, louse, myasis of medical importance.
- Demonstrate knowledge about anti-parasitic vaccine and drugs.

Applied Microbiology

- Demonstrate knowledge about epidemiology of infectious diseases
- Demonstrate knowledge about antimicrobial prophylaxis and therapy
- Demonstrate knowledge about hospital acquired infections
- Demonstrate knowledge about management of biomedical waste
- Effectively investigate an infectious outbreak in hospital and community
- 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.
- Demonstrate knowledge about opportunistic infections
- Demonstrate knowledge about various sexually transmitted diseases
- Demonstrate knowledge about principles, methods of preparation, administration and types of vaccines
- Effectively use information technology (Computers) in microbiology
- Demonstrate knowledge and applications of Automation in Microbiology
- Demonstrate knowledge and applications about molecular techniques in the laboratory diagnosis of infectious diseases
- Demonstrate knowledge in statistical analysis of microbiological data and research methodology
- Demonstrate knowledge in animal and human ethics involved in microbiology
- Demonstrate knowledge in safety in laboratory and Laboratory management

Affective Domain:

- 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.
- 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.
- 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.

Psychomotor domain:

- Collection/transportation of specimens for microbiological investigations

- Preparation, examination and interpretation of direct smears from clinical specimens
- Plating of clinical specimens on media for isolation, purification, identification and quantification purposes.
- Preparation of stains viz. Gram, Albert's, Ziehl Neelsen (ZN), Silver impregnation stain and special stains for capsule and spore etc.
- Preparation and pouring of media like Nutrient agar, Blood Agar, Mac-Conkey agar, Sugars, Kligler iron agar/Triple sugar iron agar (TSI), Robertson's cooked meat broth, Lowenstein Jensens medium, Sabouraud's dextrose agar etc.
- Preparation of reagents-oxidase, Kovac etc.
- Quality control of media, reagents etc.
- Operation of autoclave, hot air oven, filters like Seitz and membrane filters etc
- Care and operation of microscopes
- Washing and sterilization of glassware (including plugging and packing)
- Care, maintenance and use of common laboratory equipments like autoclave, hot air oven, water bath, centrifuge, refrigerators, incubators etc.
- Aseptic practices in laboratory and safety precautions. Selection of Personal Protective Equipment according to task and donning (gloves, mask, eye protection, gown etc).
- Sterility tests
- Identification of bacteria of medical importance up to species level (except anaerobes which could be up to generic level).
- Techniques of anaerobiosis
- Tests for Motility: hanging drop, Cragie's tube, dark ground microscopy for spirochaetes
- 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.
- 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.
- Tests for ß-lactamase production.
- Screening of gram negative isolates for ESBL and MBL
- Screening of Staphylococci for Methicillin Resistance.
- Screening of Enterococci for Vancomycin resistance.
- Testing of disinfectants.
- Quantitative analysis of urine by pour plate method and semi quantitative analysis by standard loop tests for finding significant bacteriuria
- Disposal of contaminated materials like cultures
- Disposal of infectious waste
- Bacteriological tests for water, air and milk
- Maintenance and preservation of bacterial cultures

Time frame to acquire knowledge & skills:

- **Knowledge :**

End of 1st year	End of 2nd year	End of 3rd year
GENERAL MICROBIOLOGY : 1. History and Pioneers in Microbiology	**IMMUNOLOGY : Clinical** 1. Hypersensitivity 2. Immunodeficiency 3. Auto-immunity	**GENERAL MICROBIOLOGY & IMMUNOLOGY :** **ALL**

2. Microscopy 3. Nomenclature and classification of microbes 4. Morphology of bacteria and other micro-organisms 5. Growth and Nutrition of bacteria 6. Bacterial metabolism 7. Sterilization and disinfection 8. Culture media and culture methods 9. Identification of bacteria 10. Bacterial toxins 11. Bacterial antagonism: Bacteriocins 12. Bacterial genetics 13. Gene cloning 14. Antibacterial substances used in the treatment of infections and drug resistance in bacteria 15. Bacterial ecology - Normal flora of human body, Hospital environment, Air, Water and Milk 16. Host-parasite relationship	4. Immune tolerance 5. Transplantation immunity 6. Tumour immunity 7. Immunoprophylaxis and immunotherapy 8. Measurement of immunity	
IMMUNOLOGY : 1. Innate and acquired immunity 2. Antigens 3. Immunoglobulins 4. Antigen and antibody Reactions 5. Complement System 6. the normal immune system: structure and function 7. Immune Response	**SYSTEMATIC BACTERIOLOGY** 1. Streptococcus and Lactobacillus 2. Staphylococcus and Micrococcus 3. Pseudomonas 4. The Enterobacteriaceae 5. Mycobacteria 6. Corynebacterium and other Coryneform bacteria 7. Vibrios, Aeromonas, Plesiomonas, Campylobacter & Spirillum 8. Neisseria, Branhamella & Moraxella 9. Haemophilus and Bordetella 10. Bacillus : the aerobic spore-bearing bacilli	**SYSTEMATIC BACTERIOLOGY (2nd year) :** **plus** 1. Actinomycetes, Nocardia and Actinobacillus 2. Erysipelothrix and Listeria 3. The Bacteroidaceae: Bacteroides, Fusobacterium and Leptotrichia 4. Chromobacterium, flavobacterium, Acinetobacter and Alkaligenes 5. Pasteurella, Francisella 6. Brucella 7. Chlamydia 8. Rikettside 9. Mycoplasmatales: Mycoplasma,

	11. Clostridium : the spore-bearing anaerobic bacilli 12. Non-sporing anaerobe 13. The Spirochaetes	Ureaplasma and Acholeplasma 10. Miscellaneous bacteria
MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES 1. Normal Microbial flora 2. Epidemiology of infectious diseases 3. Hospital acquired infections & Hospital waste disposal 4. Bacteriology of water milk and air	**VIRIOLOGY** 1.The nature of viruses 2. Classification of viruses 3. Morphology: virus structure 4.Virus replication 5.The genetics of viruses 6.The pathogenicity & lab diagnosis of viruses 7.Epidemiology of viral infections 8.Anti-viral drugs 9.Bacteriophages 10.Herpes viruses 11.Paramyxoviruses 12.Influenza virus 13.Hepatitis viruses 14.Rabies virus 15.Human immunodeficiency viruses	**VIROLOGY** (2nd year): plus 1.Vaccines 2.Pox viruses 3.Vesicular viruses 4.Toga viruses 5.Bunya viruses 6.Arena viruses 7.Marburg and Ebola viruses 8.Rubella virus 9.Orbi viruses 10.Respiratory diseases : Rhinoviruses, adenoviruses and corona viruses 11.Enteroviruses; Polio, Echo, and Coxsackie viruses 12.Other enteric viruses 13.Slow viruses 14.Oncogenic viruses 15.Teratogenic viruses
	PARASITOLOGY: 1.General Parasitology 2. **Protozoan parasites of medical importance:** Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium	**PARASITOLOGY (2nd year): plus** **1.Protozoan parasites of medical importance:** Toxoplasma, Sarcocystis, Cryptosporidium, Babesia, Balantidium etc. **2. Helminthology:** All those medically important helminthes belonging to Cestoda, Trematoda and Nematoda. **3. Cestodes:** Diphyllobothrium, Taenia, Echinococcus, Hymenolepis, Dipyllidium, Multiceps etc. **4.Trematodes:** Schistosomes, Fasciola, Gastrodiscoides, Paragonimus, Clonorchis, Opisthorchis etc. **5.Nematodes:** Trichuris, Trichinella, Strongyloides,

		Ancylostoma, Necator, Ascaris, Toxocara, Enterobius, Filarial worms, Dracunculus, etc. **6.Ecto-parasites:** Common arthropods and other vectors viz., Mosquito, Sand fly, Ticks, Mite, Cyclops
	MYCOLOGY 1.The morphology and reproduction in fungi 2.Classification of fungi 3.Dermatophytes 4.Candida 5.Aspergillus	**MYCOLOGY** **(2nd year): plus** 1.Contaminant and opportunistic fungi 2.Fungi causing superficial mycoses 3.Fungi causing subcutaneous mycoses 4.Fungi causing systemic infections 5.Anti-mycotic agents
		MICROBIOLOGY APPLIED TO TROPICAL MEDICINE AND RECENT ADVANCES 1.Infections of various organs and systems of human body 2.Molecular genetics as applicable to microbiology 3.Vaccinology: principle, methods of preparation, administration of vaccines. 4.Bio-terrorism **ALLIED BASIC SCIENCES** (a) Biochemistry: Basic understanding of biochemistry as applied to immunological/ molecular methods for study of microbial diseases and pathogenesis of infections. 1. Protein purification and estimation 2. Protein estimation 3. Nucleic acid purification and characterization 4.Agarose and polyacrylamide gel

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

- **Skills**

1st year residency-skills list					
Area	**Sr. No.**	**Procedure**	**Observed No.**	**Assisted No./Practice on dummy**	**Performed independently No. (under supervision**
General microbiology	1.	Microscopy for unstained preparations/ wet mount	5	5	10
	2.	Microscopy for stained preparation	5	5	10
	3.	Preparation of direct smears from clinical specimens	5	5	10
	4.	Hanging drop preparation	5	5	10

	5.	Washing, sterilization and packing of glassware	10 sessions	-	-
	6.	Infection control activities-environmental sampling	10	10	-
	7.	Identification of HAI	5	5	-
	8.	Calculation of HAI quality indicators	5	5	-
	9.	Bacteriology of water	5	5	-
	10.	Bacteriology of air	5	5	-
	11.	Antibiotic disc preparation	-	-	-
	12.	Handling of laboratory animal	-	-	-
	13.	Methods for preservation of bacteria	10	-	-
	14.	Maintenance of stock cultures	10	-	-
Staining	1.	Gram staining	10	20	30
	2.	Acid fast staining (Ziehl-Neelsen method)	10	20	30
	3.	Albert staining	5	10	10
	4.	Modified ZN staining for M. leprae	5	5	5
	5.	Modified ZN staining for Nocardia	5	5	5
	6.	IQC-staining	5	5	5
Media preparation	1.	Preparation of stains	4	4	4
	2.	Preparation of reagents	10	10	10
	3.	Preparation, plugging, pouring & 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	5	10	20

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

2nd year residency-skill list					
Area	**Sr. no.**	**Procedure**	**Observed no.**	**Assisted no./ practice on dummy**	**Performed independently no. (under supervision)**
General microbiology	1.	Microscopy for unstained preparations/ wet mount	-	-	-
	2.	Microscopy for stained preparation	-	-	-
	3.	Preparation of direct smears from clinical specimens	-	-	-

	4.	Preparation of slit skin smear for lepra bacilli	5	5	5
	5.	Hanging drop preparation	-	-	10
	6.	Washing, sterilization and packing of glassware	5 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	5 lots	-	-
	13.	Handling of laboratory animal	-	-	-
	14.	Methods for preservation of bacteria	-	5	10
	15.	Maintenance of stock cultures	-	5	10
Staining	1.	Gram staining	-	-	30
	2.	Acid fast staining (Ziehl-Neelsen method)	-	-	30
	3.	Albert staining	-	-	5
	4.	Modified ZN staining for M. leprae	-	-	5
	5.	Modified ZN staining for Nocardia	-	-	5
	6.	IQC-staining	-	-	5
Media preparation	1.	Preparation of stains	-	-	5
	2.	Preparation of reagents	-	-	15
	3.	Preparation, plugging, pouring & Quality Control (QC) of culture media	-	-	50
	4.	Operation & maintenance of autoclave	-	-	20
Bacteriology	1.	Specimen collection for Blood Culture	-	-	5
	2.	Inoculation of liquid & solid media	-	-	30
	3.	Identification test	-	-	30
	4.	Antimicrobial sensitivity testing- modified Kirby-bauer technique	-	-	30
	5.	IQC- Antibiotic disc potency	-	5	5

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

3rd year residency-skill list					
Area	**Sr. no.**	**Procedure**	**Observed no.**	**Assisted no./ practice on dummy**	**Performed 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	**-**	**-**	**5**
	4.	Modified ZN staining for M. leprae	**-**	**-**	**5**
	5.	Modified ZN staining for Nocardia	**-**	**-**	**5**
	6.	IQC-staining	**-**	**-**	**5**
Media preparation	1.	Preparation of stains	**-**	**-**	**10**
	2.	Preparation of reagents	**-**	**-**	**15**
	3.	Preparation, pouring & Quality Control (QC) of culture media	**-**	**-**	**50**
	4.	Operation & maintenance of autoclave	**-**	**-**	**20**
Bacteriology	1.	Specimen collection for Blood Culture	**-**	**-**	**5**
	2.	Inoculation of liquid & solid media	**-**	**-**	**30**
	3.	Identification test	**-**	**-**	**30**
	4.	Antimicrobial sensitivity testing- modified Kirby-bauer technique	**-**	**-**	**30**
	5.	IQC- Antibiotic disc potency	**-**	**-**	**5**
	6.	Operation of	**-**	**-**	**20**

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

SYLLABUS

Course contents:

Paper I: General Microbiology & Immunology

General Microbiology

1. History of microbiology
2. Microscopy
3. Bio-safety including universal containment, personal protective equipment for biological agents
4. Physical and biological containment

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

Immunology

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

Paper II: Systematic Bacteriology & Mycology

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, Spirillumand miscellaneous bacteria
7. Enterobacteriaceae
8. Mycobacteria
9. Spirochaetes
10. Chlamydia
11. Mycoplasmatales; Mycoplasma, Ureaplasma, Acholeplasma and other Mycoplasmas.
12. Rickettsiae, Coxiella, Bartonella etc.

Mycology

1. General characteristics and classification of fungi
2. Morphology and reproduction of fungi
3. Isolation and identification of fungi
4. Tissue reactions to fungi
5. Yeasts and yeast like fungi of medical importance including Candida, Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces etc.
6. Mycelial fungi of medical importance including Aspergillus, Zygomycetes, Pseudallescheria, Fusarium, Piedra, other dematiaceous hyphomycetes and other hyalohyphomycetes etc.
7. Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffei etc.
8. Dermatophytes
9. Fungi causing Mycetoma, Chromoblatomycosis, Occulomycosis and Otomycosis.
10. Pythium insidiosum
11. Prototheca
12. Pneumocystis jirovecii infection
13. Rhinosporidium seeberi and Lacazia loboi (Loboa loboi)
14. Laboratory contaminant fungi
15. Mycetismand mycotoxicosis
16. Antifungal agents and in vitro antifungal susceptibility tests.

Paper III: Virology & Parasitology

Virology

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

12. Hepatitis viruses
13. Viriods, prions
14. Vaccines and anti-viral drugs.

Parasitology

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

Paper IV: Applied Microbiology & Recent Advances

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
16. Recent Advances in the field of Medical Microbiology

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/ In charge.

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

- Collection of specimens, smear examination, culture and sensitivity analysis
- Discussion during routine activities such as during signing out of cases.
- Presentation and work-up of cases including the identification of special stains and ancillary procedures needed.
- Clinico-microbiological conferences, active involvement with hospital 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.

ASSESSMENT

FORMATIVE ASSESSMENT, i.e., assessment during the training
Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, 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.

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. 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:
   Paper I: General Microbiology and Immunology

Paper II: Systematic Bacteriology and Mycology
Paper III: Virology Parasitology
Paper IV: 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

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

   Virology:
   1. Preparation of tissue cultures
   2. Virus Titration
   3. Haemagglutination and its inhibition test
   4. Virus Neutralization Test
   5. Other rapid tests for diagnosis of viral infections

   Mycology
   1. Identification of fungal cultures
   2. Slide culture techniques
   3. Examination of histopathology slides for fungi

   Parasitology
   1. Processing and Identification of ova and cysts in stool samples
   2. Amoebic Serology
   3. Microscopic Slides
   4. Examination of histopathology slides for parasites
   5. Spots: 10 spots

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

Recommended Reading:

Books (Latest edition)

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

Journals

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

Annexure - I

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 OF HOD

MODEL PAPER

M.D.-9111 **Micro.-I**

MD Examination Month, Year
MICROBIOLOGY

Paper-I
General Microbiology & Immunology

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q.1	Write about bio safety cabinets for the clinical laboratory.	20
Q.2	Write in detail: (a) Immune complex syndrome type III reaction. (b) Epidemiology of infectious diseases	2x15=30
Q.3	Write short notes on: (a) Newer techniques in Microscopy (b) Adjuvants in vaccine (c) Th 17 cells (d) Alternate complement pathway (e) Transposons	5x10=50

MODEL PAPER

M.D.-9112 **Micro.-II**

MD Examination Month Year
MICROBIOLOGY

Paper-II
Systematic Bacteriology & Mycology

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q.1 Describe approach to an outbreak of food born disease? Write in detail about the likely role played by the Microbiologist in investigations of such a case. 20

Q.2 Write in detail: 2x15=30
(a) Update of drug resistance in mycobacterium tuberculosis in Asian countries
(b) Changing face of nosocomial candidemia

Q.3 Write short notes on: 5x10=50
(a) Methicillin resistant staphylococcus aureus
(b) Genital mycoplasma.
(c) Biomarkers in diagnosis of invasive fungal infections
(d) Echinocandins in treatment of invasive fungal infections
(e) Mycetoma in India

MODEL PAPER

M.D.-9113 **Micro.-III**

MD Examination Month Year
MICROBIOLOGY

Paper-III
Virology & Parasitology

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q.1 Outline epidemiology and diagnosis of rotavirus infections. Describe current status of rotavirus vaccine. 20

Q.2 Write in detail: 2x15=30
(a) Outline immunity in malaria. What is transfusion malaria? Describe present status of malaria vaccine
(b) i. Japanese encephalitis outbreaks in India
ii. Central nervous system and parasitic infections

Q.3 Write short notes on: 5x10=50
(a) Dependent viruses
(b) Laboratory diagnosis of amoebic liver abscess
(c) Preservation of stool samples
(d) Cell cultures use in virology
(e) Leishmaniasis in India

MODEL PAPER

M.D.-9114 **Micro.-IV**

MD Examination Month Year
MICROBIOLOGY

Paper-IV
Applied Microbiology & Recent Advances

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q.1 Discuss subunit and reverse vaccine technologies. Outline HIV vaccine development and present status. 20

Q.2 Write in detail: 2x15=30
(a) Automation in diagnostic microbiology laboratory
(b) Newer diagnostic methods for detection of MDR-TB

Q.3 Write short notes on: 5x10=50
(a) Role of probiotics to prevent diarrhoeal disease
(b) Diagnosis of prion diseases.
(c) Isothermal amplification techniques
(d) Antibiotic stewardship
(e) Accreditation of micro-biology laboratory