

HAMDARD INSTITUTE OF MEDICAL SCIENCES
AND RESEARCH
JAMIA HAMDARD
NEW DELHI-62



M.SC MEDICAL MICROBIOLOGY
SYLLABUS AND CURRICULUM

Charoo Kans
4-08-22

Dr. Charoo Kans
Head
Department of Microbiology
NIMSR & HAMD Hospital
New Delhi-110052

MASTERS IN MEDICAL MICROBIOLOGY

a)	Name of the course	M.Sc in Medical Microbiology
b)	Nature	Regular
c)	Duration	Three years
d)	Medium of instruction and examinations	English
e)	Eligibility	55% marks in Bachelor degree
f)	Commencement of the course	July of every year
g)	Mode of Admission	As per the norms prescribed by Jamia Hamdard from time to time.
h)	Period of completion (span period)	Not more than 04 years
i)	Fees	As per university norms
j)	Total Number of Students per year	05
k)	Total Theory paper	4 theory and 1 practical. Total marks 100*5=500 Candidate will have to pass theory and practical examinations separately
l)	Total number of credits	1 st year- as per MBBS 1 st year 2 nd and 3 rd year- 140 (each year 70)
m)	Number of papers carry over	01
n)	Minimum pass mark	50%, Grade C
o)	Eligibility to appear in University Exam	Minimum 50% marks in Internal assessment and the Credit points mentioned


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M.Sc. MEDICAL MICROBIOLOGY

Goal & Objectives

A candidate upon successful completion of in M.Sc Microbiology course should be able to -

1. Be competent in microbiological techniques.
2. Establish good laboratory techniques in hospital and in the community in the fields of Bacteriology, Virology, Mycology, and Parasitology & Immunology.
3. Conduct experimental research having a significant bearing on human health.
4. Plan, execute, analyze & present the research work in medical microbiology.
5. Interact with allied Department by rendering services to advanced laboratory investigations.
6. Acquire skills in conducting collaborative research in the field of Microbiology and Allied Sciences.
7. They are also imparted training in teaching methods in the subject which may enable them to take up teaching assignments in Medical /Dental Colleges/Degree Institutes.
8. Must be able to demonstrate to the students how the knowledge of Microbiology can be used in variety of clinical settings to solve diagnostic problems.

Eligibility:

Candidates with the degree in Bachelor of Science with Microbiology as one of subjects, MBBS*& BDS with minimum of 55 % Marks.

*MBBS qualified students are eligible for M.Sc PhD programme with lateral entry in 2nd year of MSc. in Medical Microbiology. MBBS candidates who have registered for M.Sc PhD programme in Medical Microbiology will be exempted from entrance test but will have to appear in interview for PhD enrolment.

Duration:

Duration- 3 years.

First year- detail theory and practical classes in Anatomy, Physiology, Biochemistry.

2nd and 3rd year- Training in various sections of Microbiology.

Course overview:

The course will be divided into 2+4 semesters. The first two semesters will include applied aspect of basic Anatomy, Biochemistry, Physiology. The next four semester will focus on various sections of Medical Microbiology. The students will be involved in theory classes, clinical postings, seminars, journal club and practical classes. At the end of each semester the students will take up the Theory, Viva and Practical Exam.

Course Content (syllabus) For First Year: Common for All Medical MSc courses

Course Content (syllabus) For IInd Year and IIIrd Year M.Sc Medical Microbiology:

The postgraduate students will attend the Department of Microbiology during the prescribed two years of course (2nd and 3rd Year). They will be required to have attendance as per university norms. Candidate shall be given full time responsibility and assignments. Postgraduate students must maintain a record book of the work carried out by them and the training undergone by them during the period of training. These record books shall be checked and assessed by the faculty.

1. TEACHING/LEARNING METHODS:

Learning in M.Sc Medical Microbiology will essentially be an active-learning process.

Following teaching-learning methods shall be followed-

a) Lectures and Practical classes

b) Group teaching sessions: -

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

c) Hands on experience (practical training)

Practical training shall be imparted by posting the students in various sub-specialities (sections) by rotation. Student shall be actively involved in day to day working of all the sections. He/she will be trained under the guidance of teachers in all the aspects of Clinical Microbiology and applied aspects of laboratory medicine including collection and transport of specimens, receiving of samples, preparation of reagents, chemicals, media and glassware, sample processing and reporting, sterilization procedures, bio-safety precautions, maintenance of equipments, record keeping and quality control in Microbiology.

2.Suggested schedule of rotation:

- i. Bacteriology (Aerobic and anaerobic)
- ii. Mycobacteriology
- iii. Hospital infection surveillance
- iv. Serology/Immunology
- v. Mycology
- vi. Virology/HIV/ICTC
- vii. Parasitology
- viii. Media preparation and Sterilization procedures
- ix. Molecular microbiology

3.Thesis/Dissertation.

- 1) Every candidate shall carry out work on an assigned research project under the guidance of a recognized Postgraduate teacher, the project shall be written and submitted in the form of a Thesis.
- 2) Every candidate shall submit thesis plan to the university as per university guidelines.
- 3) Thesis shall be submitted to the university as per university guidelines.
- 4) The student will Identify a relevant research question; conduct a critical review of literature; formulate a hypothesis; determine the most suitable study design; state the objectives of the study; prepare a study protocol; undertake a study according to the protocol; analyze and interpret research data, and draw conclusions; write a research paper.
- 5) At least 12 months should be spent on the research project.
- 6) The dissertation shall be completed and submitted by the student three months before appearing for the final university examination.

4.BROAD AREAS OF STUDY :

I)Theory:

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

a) General Microbiology

1. History of microbiology
2. Microscopy
3. Guidelines for collection,transport,processing,analysis and reporting of clinical samples in Microbiology laboratory
4. Sterilization and disinfection
5. Morphology of bacteria and other microorganisms
6. Nomenclature and classification of microorganisms
7. Normal flora of human body

8. Growth & nutrition of bacteria
9. Identification of bacteria
10. Culture media
11. Culture methods
12. Molecular biology techniques
13. Microbiology of air, milk and water
14. Host-parasite relationship
15. Antibacterial substances and drug resistance
16. Bacterial genetics
17. Bioterrorism
18. Quality assurance & quality control in microbiology
19. Accreditation of laboratories
21. Biosafety practices in clinical microbiology laboratory
22. Hospital acquired infections-types, surveillance and prevention
23. Laboratory diagnosis of bacteria
24. Antibiotic Sensitivity Testing
25. Automation in Microbiology
26. Accreditation of laboratories

b) Immunology

1. The immune system: structure, components and function
2. Types of immunity
3. Antigens
4. Immunoglobulins.
5. Complement
6. Antigen and antibody reactions
7. Hypersensitivity
8. Cell mediated immunity.
9. Immunodeficiency.
10. Autoimmunity
11. Immune tolerance.
12. Transplantation immunity.
13. Tumour immunity.
14. Immunology based therapy of diseases
 - Transplantation and transfusion
 - Immunoprophylaxis
 - Neoantigen discovery and checkpoint blockade
15. Immunological techniques
16. Immunomodulation

c) Basic Computers:

Introduction to Computers Science; Introduction to Data-Base; Introduction to Windows; Windows Application (Word, Excel, PowerPoint and Multimedia);

Introduction to Medical Informatics & use of Statistical Package; Introduction to UNIX & C; Computer Aided Teaching & testing

d) **Systematic bacteriology**

1. Isolation & identification of bacteria
2. Gram positive cocci of medical importance including Staphylococcus, Micrococcus, Streptococcus, Enterococci, Pneumococci, anaerobic cocci etc.
3. Gram negative aerobic cocci of medical importance including Neisseria, Branhamella, Moraxella etc.
4. Gram positive bacilli of medical importance including Lactobacillus, Corynebacterium, Bacillus, Clostridium, Actinomycetes, Nocardia, Erysipelothrix, Listeria etc
5. Gram negative bacilli of medical importance including Vibrios, Aeromonas, Plesiomonas, Haemophilus, Bordetella, Brucella, Gardnerella, Pseudomonas & other non-fermenters, Pasturella, Francisella, Bacteroides, Fusobacterium etc.
6. Helicobacter, Campylobacter & Spirillum
7. Enterobacteriaceae
8. Mycobacteria
9. Anaerobic bacteriology including lab diagnosis
10. Spirochaetes
11. Chlamydiae
12. Mycoplasmatales: Mycoplasma, Ureaplasma, Achleplasma and other
13. Mycoplasmas.
14. Rickettsiae, Coxiella, Bartonella etc.
15. Chromobacterium, Flavobacterium, Acinetobacter and Alkaligenes
16. Miscellaneous bacteria

e) **Mycology**

1. General characteristics & classification of fungi
2. Morphology & reproduction of fungi
3. Isolation & identification of fungi
4. Host 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.
7. Pseudoallescheria, Fusarium, Piedra, other demataceous hyphomycetes and other hyalohyphomycetes etc.
8. Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix, Penicillium marneffeii etc.
9. Dermatophytes
10. Fungi causing mycetoma, keratomycosis & otomycosis.
11. Pneumocystis carinii infection
12. Rhinosporidium seeberi.

13. Common laboratory contaminant fungi
14. Mycetoma & mycotoxicosis
15. Antifungal agents & invitro antifungal susceptibility tests.
16. Newer Fungi
17. Recent advances in diagnosis of fungal infection

f) Virology

1. Introduction to Virology including a:Classification of viruses b:Morphology: virus structure c:Virus replication d:The genetics of viruses e:The pathogenicity of viruses f:Epidemiology of viral infections g:Vaccines and antiviral drugs h:lab diagnosis of viruses including collection,transport,isolation etc.
2. Bacteriophages
3. DNA virus:Pox,Herpes,Adeno,Hepadna,Parvo etc
4. RNA viruses:Entero,Toga,Flavi,Orthomyxo,Paramyxo,Reo,Rhabdo,Arena,Bunya,Filo, Arbo etc
5. Slow virus diseases including Prion diseases
6. Retrovirus,HIV
7. Unclassified viruses
8. Teratogenic viruses,
9. Carcinogenic viruses
10. 10.Recent advances in diagnosis of viral infection

g) Parasitology

1. Introduction to parasitology:Classification,general characteristics and lab diagnosis.
2. Protozoan parasites of medical importance: Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma, Sarcocystis, Cryptosporidium, Balantidium, Isospora, Cyclospora, Microsporidium etc.
3. Helminthology: All medically important helminths belonging to Cestoda, Trematoda and Nematoda.
4. Cestodes: Diphyllbothrium Taenia, Echinococcus, Hymenolepis, Dypyllidium, Multiceps etc.
5. Trematodes: Schistosomes, Fasciola, Gastrodiscoides. Paragonimus, Clonorchis, Opisthorchis etc.
6. Nematodes: Trichuris, Trichinella, Strongyloides, Ancylostoma, Necator, Ascaris. Toxocara, Enterobius, Filarial worms, Dracunculus etc.
7. Ectoparasites: Common arthropods and other vectors .
8. Antiparasitic agents
9. Drug resistance in parasites
10. Recent advances in parasitology

h) Biostatistics

Definition of selected terms Scale of measurements related to statistics; Methods of collecting data; Presentation of data statistical tables; Measures of dispersion. Range quartile deviation, mean deviation & relative deviation; Concepts of statistical population and sample, need for sampling studies; Simple procedures of random sampling; Methods of sampling; Probability : Basic concepts; Basic theorems of probability addition and multiplication theorems; Conditional probability of Bayes Theorems; Probability distribution definition & applications; Logic of statistical standard error estimation testing of hypothesis; Tests of significance : Normal deviate tests (Z test); Student's "t" test; Chi-Square test; F test and analysis of variance; Correlation concept and applications; Regression concept and application.

i) Clinical Microbiology / Applied Microbiology

1. Epidemiology of infectious diseases
2. Hospital acquired infections
3. Management of hospital waste
4. Investigation of an infectious outbreak
5. Infections of various organs and systems of human body and their lab diagnosis viz. respiratory tract infections, urinary tract infections, central nervous system infections, congenital infections, reproductive tract infections, gastrointestinal infections, hepatitis, pyrexia of unknown origin, infections of eye, ear & nose, skin & wound infections septicaemia, endocarditis, haemorrhagic fever etc.
6. Opportunistic infections.
7. Sexually transmitted diseases
8. Vaccinology: principle, methods of preparation, administration of vaccines
9. Information technology (Computers) in microbiology
10. Molecular techniques as applicable to microbiology
11. Epidemiological typing techniques

12. Statistical analysis of microbiological data and research methodology
13. Animal & human ethics involved in microbiological work
14. Recent Advances in Medical Microbiology

II) Practical (skills)

a) Bacteriology: Must acquire

1. Care and operation of Microscopes viz. Light, Dark ground, Phase contrast, Fluorescence microscopes, etc.
2. Preparation of stains viz. Gram's Albert's, Ziehl -Neelsen and other special stains and performing of staining.

3. Washing and sterilization including plugging and packing.
4. Handling & operation of autoclave, hot air oven, distillation plant, microbial filters and sterility tests.
5. Care and maintenance of common laboratory equipments.
6. Preparation of various liquid and solid media.
7. Preparation of reagents required for routine diagnosis.
8. Tests for in-vitro drug resistance.
9. Collection of specimens for Microbiological investigations such as blood, urine, throat swab, rectal swab, stool, pus, OT specimens.
10. Preparation, examination and interpretation of direct smears from clinical specimens, viz. gram stain, sputum for AFB – ZN & auramine O, slit smears for M.Leprae.-ZN stain, conjunctival smear for Chlamydiae Giemsa/Iodine.
11. Techniques of anaerobiosis.
12. Identification of bacteria of medical importance upto species level (except anaerobes – upto generic level)
13. Quantitative and semi-quantitative analysis of urine.
14. Plating of clinical specimens on media for isolation, purification identification and quantitation.
15. Techniques to demonstrate the motility.
16. In vitro toxigenicity tests.
17. Special tests.
18. Preparation of antibiotic discs & performance of antimicrobial susceptibility testing.
19. Skin tests like Mantoux, Lepromin etc.
20. Standard practices in laboratory and safety precautions.
21. Quality control of media reagents etc.
22. Aseptic practices in laboratory and safety precautions
23. Disposal of infectious/ contaminated material.
24. Experiment with laboratory animals if possible.
25. Bacteriology of food, water, milk, air.

Desirable to acquire

1. Conjugation experiments.
2. Phage typing.
3. Bacteriocin typing.
4. Antimicrobial susceptibility tests.

b) Immunology

1. Collection of blood by venepuncture, separation of serum and preservation of serum for short and long periods.
2. Preparation of adjuvants like Freund's adjuvant.
3. Performance of serological tests.

c) Mycology

1. Collection of specimens.
2. Direct examination of specimens by KOH, Lactophenol cotton blue stains
3. Examination of histopathology slides for fungal infections

4. Isolation and identification of common laboratory contaminants and pathogenic yeasts and moulds.
5. Special techniques.
6. Maintenance of stock cultures.
7. animal pathogenicity tests if fusible

d) Parasitology : Must acquire:

1. Examination of feces for parasitic ova and cysts etc. by direct and concentration methods.
2. Egg counting techniques for helminths.
3. Examination of blood for protozoa and helminthes.
4. Examinations of other specimens for e.g. urine, C.S.F. bone marrow etc. for parasites.
5. Histopathology sections-examination and identification of parasites.
6. Staining techniques-Leishman, Giemsa, Modified Acid Fast, Trichrome.
7. Identification of common arthropods and other vectors.
8. Collection of specimens
9. Preservation of parasites.

Desirable to acquire:

1. In-vitro culture of parasites like leishmania, Entamoeba histolytica etc.
2. Preparation of media – NIH, NNN etc.
3. Permanent staining techniques.

e) Virology

Must acquire:

1. Preparation of glassware for tissue culture (washing, sterilization)
2. Preparation of media.
3. Preparation of clinical specimens for isolation of viruses.
4. Viral Serological tests.

f)Molecular microbiology

- 1.DNA/RNA extraction
- 2.PCR
- 3.Gel electrophoresis

g)Sample collection

- 1.Blood Collection
- 2.Slit skin smear
- 3.Collection of vaginal/miscellenious swab,pus aspiration.Skin scrapping,urine collection etc.
- 4.Giving PPD

SKILL LIST

Sr No

1

Area

General Microbiology

Procedure

Microscopy for unstained preparations/
wet mount
Microscopy for stained preparation
Preparation of slit skin smear for lepra bacilli
Hanging drop preparation
Washing, sterilization and packing of glassware
Infection control activities
Environmental Sampling
Identification of HAI
Calculation of HAI quality indicators
Bacteriology of water
Bacteriology of air
Antibiotic disc preparation
Handling of laboratory animal
Methods for preservation of bacteria
Maintenance of stock cultures

2

Staining

Gram staining
Acid fast staining (Ziehl- Neelsen method)
Albert staining
Modified ZN staining for *M. leprae*
Modified ZN staining for *Nocardia*
IQC-staining
Giemsa and Leishman stain
Negative staining
Fluorescent stain

3

**Media
preparation**

Preparation of stains
Preparation of reagents
Preparation, pouring & Quality Control (QC) of culture media
Operation & maintenance of autoclave
Preparation of biochemical tests

4

Bacteriology

Specimen collection
Reporting of clinical specimens including Direct smears including CSF, urine, pus, sputum etc
Inoculation of liquid & solid media
Identification test:biochemical tests
Antimicrobial sensitivity testing- modified Kirby- bauer technique, E test, MIC by micro broth dilution Stokes method

		<p>IQC- Antibiotic disc potency</p> <p>Operation of BacT/ALERT</p> <p>Operation of Vitek 2 compact</p> <p>AFB culture techniques</p> <p>Modified Petroff's method and other concentration techniques</p> <p>Anerobic culture methods</p> <p>Maintenance of Stock culture</p>
5	Mycology	<p>KOH Wet mount</p> <p>Germ tube test</p> <p>Fungal culture including Slide culture</p> <p>Negative staining for fungus</p> <p>LPCB mount</p> <p>Biochemical tests and AST</p>
6	Parasitology	<p>Giemsa staining for thick & thin peripheral blood smear</p> <p>Stool wet mount for R/M</p> <p>Stool concentration techniques</p> <p>Modified ZN staining for <i>C. parvum</i></p> <p>Harda mori culture techniques</p>
7	Serology/ Immunology	<p>Phlebotomy & separation of serum</p> <p>Operation & maintenance of mini-VIDAS</p> <p>Operation & maintenance of ELISA reader & washer</p> <p>Performance of serological tests</p> <p>Latex agglutination test(RA, ASO, CRP)</p> <p>RPR card test</p> <p>Tube agglutination test</p> <p>Gold conjugate Rapid card test</p> <p>ANA by IF</p> <p>ANA by Immunoblot</p> <p>IQC-serology</p> <p>Performance of ELISA</p> <p>DNA/RNA Extraction</p> <p>PCR</p> <p>Gel Electrophoresis</p>

		<p>Sample collection</p> <ol style="list-style-type: none"> 1. Blood Collection 2. Slit skin smear 3. Collection of vaginal/miscellaneous swab, pus aspiration, Skin scrapping, urine collection etc. 4. Giving PPD

III: Clinical Lab Postings: The students will be posted in the following departments
 Bacteriology, Mycology, Serology, parasitology, Mycobacteriology, Molecular microbiology, Immunology, Media Preparation and sterilization and sample collection.

5) Examinations:

- The pass percentage will be 50%.
- Candidate will have to pass theory and practical examinations separately.

1) 2nd year annual examination: To be conducted by July every year

Total 500 Marks

- Theory 1- General Microbiology 100 Marks(75+25)
- Theory 2- Systemic Bacteriology 100 Marks(75+25)
- Theory 3- Immunology 100 Marks(75+25)
- Theory 4- Virology 100 Marks(75+25)
- Practical examination (2 day) + Viva 100 Marks(75+25)

Internal Assessment

25 marks for each paper

The Department will conduct one pre-university exam including 4 theory paper and 1 practical exam. Internal assessment marks will be calculated from this exam and the sessionals conducted round the year. To appear in final exam students have to get 50% in internal assessment and should complete the credit points mentioned. Anyone who doesn't have 50% marks in internal assessment and the credit points mentioned wont be able to appear in the final University exam.

II) 3rd year annual examination: To be conducted by July every year

Total 500 Marks

- Theory 1- General Microbiology + Immunology 100 Marks(75+25)
- Theory 2- Systemic Bacteriology + Mycology 100 Marks(75+25)
- Theory 3- Virology + Parasitology 100 Marks(75+25)
- Theory 4- Clinical Microbiology + molecular biology 100 Marks(75+25)
- Practical examination (2 day) + Viva 100 Marks(75+25)

*Internal assessment**

25 Marks each paper

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The Department will conduct one preuniversity exam including 4 theory paper and 1 practical exam. Internal assessment marks will be calculated from this exam and the sessionals conducted round the year. To appear in final exam students have to get 50% in internal assessment and should complete the credit points mentioned. Anyone who doesn't have 50% marks in internal assessment and the credit points mentioned won't be able to appear in the final University exam.

Basic Computers and Statistics will be taught, a qualifying exam will be taken in the Department, but these two papers are not included in the University Exam.

III) Minimum Credits : 140 points

	Theory	Seminar	Journal Club	Credits
2 nd year	66	2	2	70
3 rd year	66	2	2	70
Total				140

1 hour Theory= 1 credit, 1 hour sgd/group discussion/tutorial = 1 credit, 1 seminar =1 credit, 1 journal club= 1 credit

6) Scheme of Practical examinations.

Marks distribution for 2nd year students

Culture identification Marks (15+10=25)	Special Stain Marks (10)		Viva Marks (20)	Internal Assessment (25)
A mixed culture and A pure culture broth to be given		Serology Marks (10)	Spotting Marks (10)	

Marks Distribution for 3rd Year M.Sc. Students

Thesis viva(5)	Culture identification Marks (25)	Special Stain Marks (10)	Parasitology Marks (5)	Mycology Marks (5)	Serology Marks (5)	Spotting Marks (5)	Viva Marks (20)	Internal Assessment (25)
	A mixed culture and A pure culture broth to be given							

Students have to maintain a log book.

7)Time Table:

Day	9.00-10.00	10.00-11.00	11.00-12.00	12.00-1.00	2.00- 3.00	3.00-4.00
Monday	Lab posting			Theory	Lab posting	
Tuesday	Lab posting				Seminar	
Wednesday	Lab posting			Theory	Lab posting	
Thursday	Lab posting				Journal club	
Friday	Lab posting				Tutorials/ discussion group	
Saturday	Lab posting				Lab posting	

Lunch Break

8) Examiners: There shall be one Internal Examiner(HOD) and one External Examiner. If HOD is not available then the next senior most faculty will act as the Internal Examiner (Associate Professor and above).

Eligibility Criteria for Being Internal/External examiner: 4 year post MD/PHD

9) Scheme of Marks in Final Theory paper

Long question	15*2=30
Short question	7* 5=35
MCQ	10
Theory total	75

10) Text Books

1. Ananthanarayan & Paniker's Textbook of Microbiology. 7th edition. Orient Longman, India; 2007.
2. Anaissie Elias J. Clinical Mycology, Churchill Livingstone 2003.
3. Bailey and Scott's Diagnostic Microbiology. 9th ed. CV Mosby, St. Louis, 2003.
4. Brooks, Geo F Jawetz Medical Microbiology 22nd ed McGraw Hill 2001. 52
5. Collier, Leslie Topley and Wilsons Microbiology and microbial infections Vol 1. 2, 3, 4, 5, 6 9th edition
6. Collee J G Mackie and McCartney Practical Medical Microbiology 14th ed 1999.
7. Koneman EW, Allen SD, Schreckenber PC, Winn WC (Eds): Atlas and Textbook of Diagnostic Microbiology. 4th ed. JB Lippincott, Philadelphia. 1992.
8. Murray PR, Baron EJ, Pfaller MA, Tenover PC. and Tenover RH (Eds): Manual of Clinical Microbiology. 6th ed. American Society for Microbiology, Washington, DC, 2005.
9. Parija SC. Textbook of Medical Parasitology .3rd Edition 2008. All India Publishers and Distributors, New Delhi. India
10. Parija SC. Textbook of Practical Microbiology. 1st Edition, 2007 Ahuja Publishing House , New Delhi , India .
11. Roitt Ivan M, Immunology 10th edition Blackwell Science 1994.
12. Bajjainthimala Mishra. Textbook of Medical Virology. 1st Edition. 2018 CBS Publishers, New Delhi
13. Stites Immunology 10th edn, Mc Graw Hill 2001.
14. Woods GL, Washington JA: The Clinician and the Microbiology Laboratory. Mandell GL, Bennett JE, Dolin R (Eds): Principles and Practice of Infectious Diseases. 4th ed. Churchill Livingstone, New York, 2002.
15. Gradwohl's Clinical Laboratory Methods and Diagnosis
16. Biochemical tests for the Identification of Medical

Bacteria MacFaddin JF 6. Manual of Clinical Microbiology- ASM press

17. Text book of Parasitology. Chatterjee K.D
18. Immunology: Janis Kuby- 2003.
19. Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases-2004, 6th edition
20. Control of Hospital Infection- A practical handbook (most recent edition)-2000, 4 th edition
21. Microbiology in Clinical Practice. Shanson D.C
22. Microbiology and Clinical Practice: Shanson-1999. 3rd edition
23. Topley and Wilson's Microbiology and Microbial infections. 8 volumes 2005, 10th edition
24. Color Atlas and Textbook of Diagnostic Microbiology: Elmer W Koneman -2006, 6th edition
25. Hospital infection control by Nizam Damani
26. Essentials of Hospital infection control by Apurba Sastry & Deepashri R
27. Mycology – Rippons

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Gandhi
4-08-22
Dr. Charoo Hans
Head
Department of Microbiology
HMSR & HATC Hospital
New Delhi-110027