

Textbook of Microbiology

Sixth
Edition

The sixth edition of *Textbook of Microbiology* is thoroughly revised and updated which aims to keep pace with the rapidly increasing information in medical sciences. A chapter on automation in microbiology has been added. Zika virus has been described in chapter of arboviruses. The text is presented in simple and lucid manner. It is illustrated with coloured and computer-drawn figures, clinical photographs and photomicrographs. These make the book colourful and readers can have better understanding of the biology of microorganisms. Each chapter ends with key facts, and essay type, short answer type and multiple choice questions. The former summarizes the whole chapter, and the latter help the student to know the type of questions asked in the examination. Overview of microbiology in the last chapter summarizes the whole book. The book is user-friendly, easy to understand, and will be highly useful to MBBS, BDS, MSc and MD microbiology students.

DR Arora, MD, PhD, MNAMS, Ex-Professor and Head, Department of Microbiology, Postgraduate Institute of Medical Sciences, Rohtak, Haryana; and Maharaja Agarsen Medical College, Agroha, Haryana; Ex-Professor and Head, Department of Microbiology, Medical Superintendent, and Dean, Faculty of Allied Health Sciences, SGT University, Gurugram, Haryana; Lead Assessor and Member, Accreditation Committee, National Accreditation Board for Testing and Calibration Laboratories (NABL), Gurugram, Haryana; Principal Assessor, National Accreditation Board for Hospitals & Healthcare Providers (NABH), New Delhi; Assessor, National Accreditation Board for Education and Training (NABET), New Delhi, has more than 43 years of teaching experience in microbiology to medical and dental undergraduate and postgraduate students. Besides conducting and supervising research in microbiology, he has published nine textbooks on microbiology, parasitology and mycology, and 150 research articles in several indexed national and international journals of repute. The results of his research on malaria parasites and *Klebsiella pneumoniae* have been cited in World Health Organization WHO/MAL/8310003 and *Topley & Wilson's Microbiology and Microbial Infections, Bacteriology*, Vol 2, 10th edn, 2005, respectively. He has supervised a number of PG students of PhD, MD and MS in appreciation of outstanding research carried out by him in India on bacteriocins of *Klebsiella pneumoniae*, he was awarded Smt. Kunti Mehrotra Award of Indian Association of Pathologists and Microbiologists in 1983. In recognition of significant contribution to the advancement of medical sciences, he was elected Member of National Academy of Medical Sciences, India in 1985. He has been a Visiting Professor at University of Mauritius in 1989. He was awarded WHO fellowship on Laboratory Aspects of HIV/AIDS and STD at Community Health Surveillance and Laboratories Administration, Baltimore, Maryland, USA in 1992. He was honoured by Indian Medical Association, Kaithal, Haryana on the eve of Doctors' Day on 01.07.1999. He has been examiner for BDS, MBBS, MD, DNB and PhD microbiology of a number of universities. His biography including academic activities and research work has been published in *Who's Who in Medicine and Healthcare* 2011–12 (8th edn), NJ 07922, USA, distinguishing him as one of the leading healthcare professionals from around the world.



Brij Bala Arora, MD, Ex-Senior Professor and Head, Department of Pathology, Postgraduate Institute of Medical Sciences, Rohtak, Haryana; Ex-Director-Principal and Senior Professor and Head, Department of Pathology, SGT Medical College, Gurugram, Haryana, had more than 42 years of teaching experience in pathology to medical, dental and nursing undergraduate and postgraduate students. She had published five textbooks, and 175 research articles in several indexed national and international journals of repute. Her research on AgNOR staining technique received international importance and paper on morphometric analysis of AgNOR in lymph node lesions was published in "Advances in Clinical Pathology 6:95-99, 2002". She had supervised 67 PG students of PhD, MD, MS, MDS and DNB. She had been examiner for BSc Nursing, BDS, MBBS, MD, DNB and PhD of a number of universities. She had been conferred MAMCOS scroll of honour in VIII Annual Conference on 20th December 1994 at Maulana Azad Medical College, New Delhi; Bharat Jyoti Award for outstanding services, achievements and contributions on 23rd June 2006 at New Delhi and International Gold Star Award 2010 for outstanding achievements at 25th Indo-Thai Entrepreneurs Summit on 27th August, 2010 at Bangkok, Thailand. Her biography including academic activities and research work has been published in *Who's Who in Medicine and Healthcare* 2011–12 (8th edn), NJ 07922, USA, distinguishing her as one of the leading healthcare professionals from around the world. She had also been conferred Lifetime Achievement Award in recognition of outstanding achievements at 33rd National Seminar on December 4th, 2012, New Delhi at Indian Achievers Forum.



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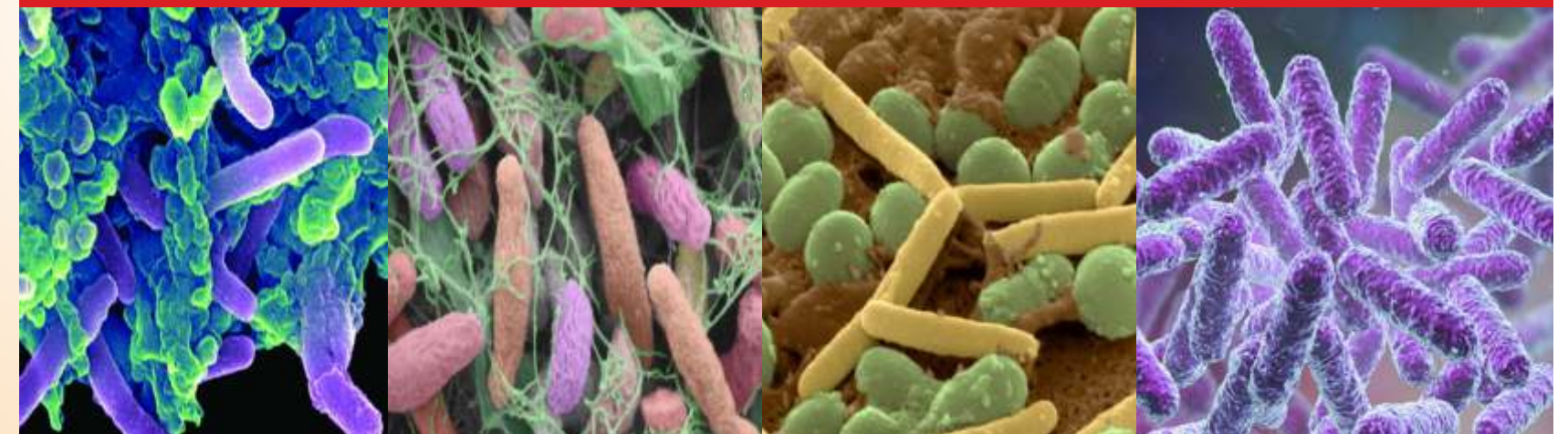
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Revised and updated as per the latest Competency Based Undergraduate Curriculum for the Indian Medical Graduate prescribed by Medical Council of India (restructured as National Medical Commission)



DR Arora
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- *Textbook of Microbiology for Dental Students*, 4th ed
- *Medical Parasitology*, 5th ed
- *Medical Mycology*, 2nd ed
- *Microbiology for Nursing & Allied Sciences*, 2nd ed
- *Practical Microbiology*, 2nd ed
- *Practical Microbiology for Dental Students*
- *Exam-Oriented Microbiology (Questions & Answers)*
- *Essentials of Microbiology for BSc Nursing Students*
- *MCQs in Microbiology and Parasitology (with Explanations)*
- *Microbiology for Medical Laboratory Technology Students*

Sixth Edition

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D R Arora MD PhD MNAMS

*Ex-Professor and Head, Department of Microbiology,
Postgraduate Institute of Medical Sciences, Rohtak, Haryana, and
Maharaja Agarsen Medical College, Agroha, Haryana*

*Ex-Professor and Head, Department of Microbiology,
Medical Superintendent and Dean, Faculty of Allied Health Sciences,
SGT University, Gurugram, Haryana*

Ex-WHO Fellow and Visiting Professor, University of Mauritius

*Lead Assessor and Member, Accreditation Committee,
National Accreditation Board for Testing and Calibration Laboratories (NABL),
Gurugram, Haryana*

*Principal Assessor, National Accreditation Board for Hospitals and
Healthcare Providers (NABH), New Delhi*

*Assessor, National Accreditation Board for
Education and Training (NABET), New Delhi*

Late Brij Bala Arora MD

*Ex-Senior Professor and Head, Department of Pathology,
Postgraduate Institute of Medical Sciences, Rohtak, Haryana*

*Ex-Director-Principal and Senior Professor and Head,
Department of Pathology, SGT Medical College, Budhera,
Gurugram, Haryana*

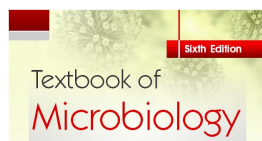


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4819/XI Prahlad Street, 24 Ansari Road, Daryaganj, New Delhi 110 002, India

Ph: 011-23289259, 23266861, 23266867

Website: www.cbspd.com

Fax: 011-23243014

e-mail: delhi@cbspd.com; cbspubs@airtelmail.in

Corporate Office: 204 FIE, Industrial Area, Patparganj, Delhi 110 092

Ph: 011-49344934

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e-mail: publishing@cbspd.com; publicity@cbspd.com

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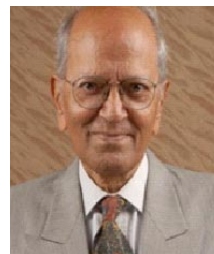
*Dedicated to the Sweet Memories of
Our Loving Daughter,
Dr Hina Arora*



Dr Hina Arora
BDS, IDES 2001
09-04-1976 to 02-11-2009

Foreword

Infectious diseases account for 26% of the total deaths in the world and this percentage is much higher in the developing world including India. A sound knowledge of the microbes that cause these diseases is vital in the understanding of their epidemiology, pathogenesis, diagnosis, management and prevention. The emergence of new microbes and the diseases caused by them due to changing environment and ecology is a challenge. The persistent problem of hospital-acquired infections in ever-increasing population of immunosuppressed patients nowadays and the difficulty of their management due to antimicrobial drug resistance and non-availability of new anti-infective molecules is a problem faced by the medical community. Microbiology is central to these challenges. India needs many more microbiologists and also needs to increase its diagnostic facilities.



The sixth edition of this book is an updated version of the previous one and elegantly meets the new requirements. Laboratory diagnosis of various microbial infections has been simplified with the help of flowcharts. The principal author, Dr D R Arora, is an accomplished undergraduate and postgraduate teacher and has mastered the art of interaction and communication for decades for the needs of the students. Late Dr Brij Bala Arora, the coauthor, has added the component of pathological basis of infectious diseases. The latest national and international references at the end of each chapter are provocative for the inquisitive minds. Each chapter has relevant, essay-type, short answer and multiple choice questions for quick references and prepares the examinees for future written and oral examinations.

This book will be useful for the students, teachers and practitioners of not only microbiology but also of family medicine and also those interested in infectious diseases. I strongly recommend the book to them as a daily and ready reckoner.

I wish to compliment the authors for doing an excellent job.

A handwritten signature in black ink, appearing to read 'T D Chugh'.

T D Chugh

National Emeritus Professor
National Academy of Medical Sciences (India)



Preface to the Sixth Edition

Human history is full of examples of major devastations caused by bacteria and viruses. Some of these historically important diseases still occur such as tuberculosis and yellow fever. Microorganisms are always one step ahead of us. We develop means (an antibiotic/a vaccine) to control/eradicate the pathogenic microorganisms and they develop genes/mechanisms to resist these means. Microorganisms are evolving to cause new infectious diseases such as Lyme disease and AIDS. On the top of that, microorganisms are being used as weapons of war. Biotechnology and genetic engineering have added new dimension to the threat whereby scientists/terrorists can alter strains of bacteria to cause atypical symptoms, acute fatal disease, and increased transmissibility, and make microorganisms resistant to usual antibiotics. Our understanding of microbiology and immunology is rapidly expanding with new discoveries in all areas. In the future, study of space microbiology may help to reveal if there is life on other planets. I, as author and teacher, used my experience to choose the most important information for inclusion in this book.

Rapidly increasing information in medical science requires that textbooks be revised and updated to keep pace. Earlier editions of the *Textbook of Microbiology* have received an overwhelming response from undergraduate and postgraduate students, and the teachers. This has played a vital role in bringing out the sixth edition of the book. Each chapter has been carefully updated and expanded to include new medically relevant discoveries. The text has been thoroughly revised as per Medical Council of India Competency-based Undergraduate Curriculum for the Indian Medical Graduate. Laboratory diagnosis of various microbial infections has been simplified with the help of flowcharts. A chapter on automation in microbiology has been added. Zika virus has been described in the chapter of arboviruses. Unnecessary details have been removed. The text is presented in a simple and lucid manner. It is illustrated with coloured and computer-drawn figures, and clinical photographs and photomicrographs. These make the book colourful and the readers can have a better understanding of the biology of microorganisms. New illustrations have been added at various places for better understanding. The book is divided into seven sections: General Bacteriology; Systemic Bacteriology; Virology; Medical Mycology; Clinical Microbiology; Bacteriology of Water, Milk and Air, and Biological Warfare; and Quality Assurance, Ethics and Overview of Microbiology. For quick review and recapitulation, key facts and multiple choice questions have been given at the end of each chapter. In order to help the students perform better in the examination, the competencies expected from the students after reading various chapters, have been given in the beginning of the chapters.

I am thankful to many students and professional colleagues who have offered their advice and constructive criticism throughout the development of sixth edition of the book. I am deeply indebted to Dr Seema Gupta MD, Professor of Pharmacology, Government Medical College, Jammu (J&K), for contributing a chapter on chemotherapy. I am also thankful to Dr PS Gill, Professor of Microbiology, Postgraduate Institute of Medical Sciences, Rohtak, for drawing the figures. I am grateful for valuable professional help and support provided by Mr YN Arjuna (Senior Vice President—Publishing, Editorial and Publicity), Ms Ritu Chawla (General Manager—Production), Mr BM Singh and other staff at CBS Publishers & Distributors Pvt Ltd. I honestly acknowledge the most sincere and dedicated support and advice of Mr Dharmvir. Thanks are also due to Mr Neeraj Sharma for thorough and careful proofreading.

This book will be highly useful to MBBS, BDS, MSc and MD microbiology students. It is also hoped that it will serve as a useful resource for teachers of microbiology and other specialities including infectious diseases. The readers are requested to send their suggestions for the improvement of the book which will be incorporated in the subsequent editions. Shortcomings, if any, may please be communicated at draroradr@rediffmail.com.

D R Arora



Preface to the First Edition

A majority of the patients seeking medical advice are suffering from some sort of infectious disease and more than one-third of total deaths in the world are associated with microbial diseases. Millions of infants die of bacterial, viral and protozoal infections, and antimicrobial drug resistance and hospital-associated infections are causing considerable alarm. The re-emergence of infectious diseases, thought to be well under control in large parts of the world, and emergence of new infections with high case fatality rates and the potential of their rapid spread have led the WHO to issue a wake up call. The eradication of smallpox and effective control of many communicable diseases has led to a false sense of security and complacency in many countries.

New agents of infectious diseases continue to be recognized. The most notorious of these is undoubtedly the human immunodeficiency virus, the causative agent of acquired immunodeficiency syndrome. It was identified in 1983. The outbreaks of plague in 1994, cholera in 1995, and dengue haemorrhagic fever in 1996, among many others, have highlighted the urgency for strengthening the disease surveillance system so that early warning signals are recognized and appropriate control measures are initiated in a timely manner.

Microbiologists face many new species, genera and families of microorganisms and some of them have been re-assigned to these. The methods of laboratory diagnosis of infectious diseases and vaccine production have been revolutionized with the development of recombinant DNA technology, polymerase chain reaction, nucleic acid probes, radioimmunoassay, enzyme-linked immunosorbent assay, etc. Therefore, a thorough knowledge of microbiology is essential to every healthcare worker. This book gives all the essential details of general microbiology, description of various microorganisms, i.e. morphology, cultural characteristics, antigenic structure, toxin production, pathogenesis, immunity, epidemiology, laboratory diagnosis, prevention and treatment.

There is a well-known saying, “prevention is better than cure”, therefore, methods of prevention of each infectious disease including vaccines have been described. However, if disease has established then an early and accurate diagnosis is essential. The same has been described in proper details giving all latest methods of diagnosis.

D R Arora

Index of Competencies

Competency-based Undergraduate Curriculum for the Indian Medical Graduate

MI1.1	Describe different causative agents of infectious diseases, the methods used in their detection, and discuss the role of microbes in health and disease.	72
MI1.2	Perform and identify different causative agents of infectious diseases by Gram stain and Ziehl-Neelsen stain.	28
MI1.3	Describe the epidemiological basis of common infectious diseases.	28
MI1.4	Classify different methods of sterilization and disinfection. Discuss the application of the different methods in the laboratory, in clinical and surgical practice.	38
MI1.5	Choose the most appropriate method of sterilization and disinfection to be used in the laboratory, in clinical and surgical practice.	38
MI1.6(a)	Describe the mechanism of drug resistance.	57
MI1.6(b)	Describe the methods of antimicrobial susceptibility testing and monitoring of antimicrobial therapy.	554
MI1.7	Describe the immunological mechanisms in health.	79
MI1.8	Describe the mechanisms of immunity and response of the host immune system to infections.	79
MI1.9(a)	Discuss the immunological basis of vaccines.	79
MI1.9(b)	Describe the universal immunization schedule.	560
MI1.10(a)	Describe the immunological mechanisms of hypersensitivity and discuss the laboratory methods used in detection of hypersensitivity.	137
MI1.10(b)	Describe the immunological mechanisms of autoimmunity.	145
MI1.10(c)	Describe immunological mechanisms in immunological disorder in immunodeficiency states.	132
MI1.11	Describe the immunological mechanisms of transplantation and tumour immunity.	150
MI2.1	Describe etiologic agents of rheumatic fever and their diagnosis.	172
MI2.2	Describe etiopathogenesis, clinical features and discuss diagnostic modalities of infective endocarditis.	172, 542
MI2.3	Identify the microbial agents causing rheumatic heart disease and infective endocarditis.	172
MI2.7	Describe the epidemiology, pathogenesis, evolution, complications, opportunistic infections, diagnosis, prevention and the principles of management of HIV infection.	469
MI3.1	Enumerate microbial agents causing diarrhoea and dysentery. Describe the epidemiology, morphology, pathogenesis, clinical features and diagnostic modalities of these agents.	267, 283, 288, 304, 542
MI3.2	Identify the common etiological agents of diarrhea and dysentery.	267, 283, 288, 304, 542
MI3.3	Describe the enteric fever pathogens and discuss the evolution of the clinical course and the laboratory diagnosis of the diseases caused by them.	288
MI3.4	Identify the different modalities for diagnosis of enteric fever. Choose the appropriate test related to the duration of illness.	288
MI3.5	Enumerate the causative agents of food poisoning and discuss the pathogenesis, clinical course and laboratory diagnosis.	163, 212, 288, 542
MI3.6	Describe the etiopathogenesis of acid peptic disease (APD) and the clinical course. Discuss the diagnosis and management of the causative agent of APD.	314
MI3.7	Describe the epidemiology, the etiopathogenesis and discuss the viral markers in the evolution of viral hepatitis. Discuss the modalities in the diagnosis and prevention of viral hepatitis.	481
MI3.8	Choose the appropriate laboratory tests in the diagnosis of viral hepatitis with emphasis on viral markers.	481
MI4.1	Enumerate the microbial agents causing anaerobic infections. Describe the etiopathogenesis, clinical course and discuss the laboratory diagnosis of anaerobic infections.	212, 247
MI4.2	Describe etiopathogenesis, clinical course and discuss the laboratory diagnosis of bone and joint infections.	163
MI4.3	Describe etiopathogenesis of infections of skin and soft tissue and discuss the clinical course and the laboratory diagnosis.	503
MI5.1	Discuss the etiopathogenesis, clinical course and discuss the laboratory diagnosis of meningitis.	183, 189, 328, 414, 429, 455, 542

MI5.2	Describe the etiopathogenesis, clinical course and discuss the laboratory diagnosis of encephalitis.	414, 429, 455
MI5.3	Identify the microbial agents causing meningitis.	183, 189, 319, 328, 414, 429, 455, 542
MI6.1	Describe the etiopathogenesis, laboratory diagnosis and prevention of infections of upper and lower respiratory tract.	28, 542
MI6.2	Identify the common etiologic agents of upper respiratory tract infections (Gram staining).	28, 163, 183, 542
MI6.3	Identify the common etiologic agents of lower respiratory tract infections (Gram stain and Ziehl-Neelsen stain).	28, 183, 542
MI7.1	Describe the etiopathogenesis and discuss laboratory diagnosis of infections of genitourinary system.	28, 542
MI7.2	Describe the etiopathogenesis and discuss the laboratory diagnosis of sexually transmitted infections. Describe the preventive measures.	28, 542
MI7.3	Describe the etiopathogenesis, clinical features, the appropriate method for specimen collection, and discuss the laboratory diagnosis of urinary tract infections.	163, 172, 189, 223, 267, 279, 314, 319, 344, 542
MI8.1	Enumerate the microbial agents and their vectors causing zoonotic diseases. Describe the morphology, mode of transmission, pathogenesis and discuss the clinical course, laboratory diagnosis and prevention.	72, 298, 435
MI8.2	Describe the etiopathogenesis of opportunistic infections (OI) and discuss the factors contributing to the occurrence of OI, and the laboratory diagnosis.	469
MI8.3	Describe the role of oncogenic viruses in the evolution of virus-associated malignancy.	492
MI8.4	Describe etiologic agents of emerging infectious diseases. Discuss the clinical course and diagnosis.	539
MI8.5	Define healthcare-associated infections (HAI) and enumerate the types. Discuss the factors that contribute to the development of HAI and the methods for prevention.	469
MI8.6	Describe the basics of infection control.	550
MI8.7	Demonstrate infection control practices and use of personal protective equipment (PPE).	550
MI8.8	Describe the methods used and significance of assessing the microbial contamination of food, water and air.	565
MI8.9	Discuss the appropriate method of collection of specimen in the performance of laboratory tests in the detection of microbial agents causing infectious disease.	28
MI8.11	Demonstrate respect for patient samples sent to the laboratory for performance of laboratory tests in the detection of microbial agents causing infectious disease.	587
MI8.12	Discuss confidentiality pertaining to patient identity in laboratory results.	581
MI8.13	Discuss the appropriate laboratory test in the diagnosis of the infectious disease.	581
MI8.14	Demonstrate confidentiality pertaining to patient identity in laboratory results.	587
MI8.15	Choose and interpret the results of the laboratory tests used in diagnosis of infectious disease.	581
MI8.16	Describe the National Health Programmes in the prevention of common infectious diseases.	560
BI10.5	Describe antigens and concept involved in vaccine development.	79, 87
PA7.5	Describe the immunology and the immune response to cancer.	150
PA9.1	Describe the principles and mechanisms involved in immunity.	117
PA9.2	Describe the mechanisms of hypersensitivity reactions.	137
PA9.3	Describe the HLA system and the immune principles involved in transplant and mechanisms of transplant rejection.	150
PA9.6	Define and describe the pathogenesis and pathology of HIV and AIDS.	469
PA10.3	Define and describe the pathogenesis and pathology of leprosy.	239
PA22.5	Enumerate and describe infections transmitted by blood transfusion.	156
PA26.4	Define and describe the etiology, types, pathogenesis, stages, morphology microscopic appearance and complications of tuberculosis.	223
PA35.1	Describe the etiology, pathogenesis, differentiating factors and CSF findings in meningitis.	542
PH1.43	Describe and discuss the rational use of antimicrobials including antibiotic stewardship programme.	550
PH1.45	Describe the drugs used in multidrug-resistant tuberculosis (MDR-TB) and extensively drug-resistant tuberculosis (XDR-TB).	223
CM3.3	Describe the etiology and basis of water-borne diseases.	565
CM3.6	Describe the role of vectors in the causation of diseases.	72
CM14.1	Define and classify hospital waste.	38
CM14.2	Describe various methods of treatment of hospital waste.	38
CM14.3	Describe laws related to hospital waste management.	38
DR7.1	Describe the etiology, microbiology, pathogenesis, clinical presentations and diagnostic features of dermatophytes.	503
DR7.2	Identify <i>Candida</i> species in fungal scrapings and KOH mount.	503
DR9.1	Classify, describe the epidemiology, microbiology, pathogenesis, clinical presentations and diagnostic features of leprosy.	239

DR10.1	Identify and classify syphilis based on the presentation and clinical manifestations.	252
DR10.2	Identify spirochete in dark-ground microscopy.	252
DR10.6	Describe the etiology, diagnostic and clinical features of non-syphilitic sexually transmitted diseases (chancroid, donovanosis, and lymphogranuloma venereum).	328, 358, 369, 542
DR10.7	Identify and differentiate based on the clinical features of non-syphilitic sexually transmitted diseases (chancroid, donovanosis and lymphogranuloma venereum).	328, 358, 369, 542
DR15.2	Identify <i>Staphylococcus</i> on a Gram stain.	163
DE1.2	Discuss the role of causative microorganisms in the etiopathogenesis of dental caries.	172, 247
DE1.4	Discuss the role of dental caries as a focus of sepsis.	172, 247
IM1.3	Describe and discuss etiology, microbiology, pathogenesis and clinical evolution of rheumatic fever, criteria, degree of rheumatic activity and rheumatic valvular heart disease and its complications including infective endocarditis.	172
IM1.22	Assist and demonstrate the proper technique in collecting specimen for blood culture.	28
IM3.1	Define, discuss, describe and distinguish community acquired pneumonia, nosocomial pneumonia and aspiration pneumonia.	183, 325, 344
IM4.13	Perform and interpret a sputum Gram stain.	28
IM4.14	Perform and interpret a sputum Ziehl-Neelsen stain.	28
IM4.19	Assist in the collection of blood and wound cultures.	28
IM4.20	Interpret a PPD (Mantoux).	223
IM5.4	Describe and discuss the epidemiology, microbiology, immunology and clinical evolution of infective (viral) hepatitis.	481
IM6.1	Describe and discuss the symptoms and signs of acute HIV seroconversion.	469
IM6.2	Define and classify HIV/AIDS based on the CDC criteria.	469
IM6.3	Describe and discuss the relationship between CD4+ T cell count and the risk of opportunistic infections.	469
IM6.4	Describe and discuss the pathogenesis, evolution and clinical features of common HIV related opportunistic infections.	469
IM6.10	Choose and interpret appropriate diagnostic tests and classify the severity of HIV/AIDS including specific tests of HIV.	469
IM6.18	Describe and discuss the principles and regimens used in post-exposure prophylaxis.	469
IM16.10	Identify <i>Vibrio cholerae</i> in a hanging drop specimen.	304
IM25.9	Assist in the collection of blood and other specimen cultures.	28
PE19.1	Explain the components of the Universal Immunization Programme and the Sub National Immunization Programmes.	560
PE26.12	Discuss the prevention of hepatitis B infection—universal precautions and immunisation.	481
PE30.13	Discuss the etiopathogenesis, clinical features, management and prevention of poliomyelitis in children.	429
PE34.7	Interpret a Mantoux test.	223
PE34.11	Perform Ziehl-Neelsen staining.	28
PE34.12	Enumerate the indications and discuss the limitation of methods of culturing <i>Mycobacterium tuberculosis</i> .	223, 377
SU13.1	Describe the immunological basis of organ transplantation.	150
SU14.1	Describe aseptic techniques, sterilization and disinfection.	38
SU15.1	Describe classification of hospital waste and appropriate methods of disposal.	38
SU29.3	Describe the clinical features, investigations and principles of management of urinary tract infection.	542
CT1.2	Describe and discuss the microbiology of tubercle bacillus, mode of transmission, pathogenesis, clinical evolution and natural history of pulmonary and extrapulmonary forms (including lymph nodes, bone and CNS) of tuberculosis.	223
CT1.7	Perform and interpret Montoux test, and describe and discuss the indications and pitfalls of the test.	223
CT1.13	Describe and discuss the origin, indications, technique of administration, efficacy and complications of BCG vaccine.	223

Contents

<i>Foreword</i>	vii
<i>Preface to the Sixth Edition</i>	ix
<i>Excerpts from Preface to the First Edition</i>	x
<i>Index of Competencies</i>	xi

Section 1: General Bacteriology

1. Introduction	3	4. Aldehydes 44	
Origin of microbial life 3		5. Alcohols 44	
The developing science of microbiology 4		6. Dyes 44	
Koch's postulates 4		7. Vapour-phase disinfectants 45	
The beginning of virology 5		8. Surface active disinfectants 45	
Contributions of various scientists in the field of microbiology 5		Biomedical Waste Management Rules, 2016 46	
2. Morphology of Bacteria	9	6. Chemotherapy	52
Size of bacteria 9		Antimicrobial agents 52	
Shape of bacteria 10		7. Bacterial Genetics	57
Group patterns 11		Structure of DNA 57	
Anatomy of a bacterial cell 11		Structure of RNA 57	
3. Growth and Nutrition of Bacteria	20	Extrachromosomal genetic elements 58	
Bacterial growth 20		Genotypic and phenotypic variations 58	
Bacterial growth curve 20		Lac operon (gene regulation) 59	
Culture media 21		Mutation 59	
Environmental factors influencing growth 23		Acquisition of new genes 61	
Culture methods 24		Antibiotic resistance 64	
Aerobic culture 25		Transposable genetic elements 65	
Culture in an atmosphere with added carbon dioxide 25		Genetic engineering (recombinant DNA technology) 65	
Culture in microaerophilic atmosphere 25		DNA probes 67	
Anaerobic culture 25		Polymerase chain reaction (PCR) 67	
4. Collection of Specimens, Identification of Bacteria and Taxonomy	28	8. Bacteria in Health and Disease	72
General rules for collection and transportation of specimen 28		Infection 72	
Identification of bacteria 30		Sources of infection 73	
Bacterial taxonomy 34		Modes of spread of infection 74	
5. Sterilization, Disinfection and Biomedical Waste Management	38	9. Immunity	79
A. Physical agents 38		I. Innate immunity 79	
1. Sunlight 38		II. Acquired immunity 82	
2. Drying 38		Adoptive immunity 84	
3. Heat 38		Local immunity 84	
4. Filtration 42		Herd immunity 84	
5. Radiations 43		10. Antigens	87
B. Chemical agents 43		Superantigens 89	
1. Phenols 43		11. Antibodies	91
2. Halogens 44		Antibody structure 91	
3. Metallic salts 44		Immunoglobulins as antigens 92	
		Immunoglobulin classes 93	
		Abnormal immunoglobulins 96	

12. The Complement System	98	Type II hypersensitivity: Cytotoxic 139	
13. Antigen–Antibody Reactions	104	Type III hypersensitivity: Immune complex 140	
Characteristics of antigen–antibody reactions 104		Type IV hypersensitivity: Cell-mediated or delayed 141	
Methods used to detect and quantitate antigen and antibody 105		Type V Hypersensitivity: Stimulatory or anti-receptor 142	
14. Architecture of the Immune System	117	Shwartzman reaction 142	
Primary lymphoid organs 117		18. Autoimmunity	145
Peripheral lymphoid organs 118		Mechanism of autoimmunity 145	
Cells of the immune system 119		Classification of autoimmune diseases 146	
15. Immune Response	124	19. Histocompatibility Systems	150
Humoral or antibody-mediated immune response 124		Types of grafts 150	
Cell-mediated immune responses 127		Allograft reaction 150	
16. Immunodeficiency Diseases	132	Major histocompatibility complex 150	
Primary immunodeficiency syndromes 132		Histocompatibility testing 151	
Secondary immunodeficiency 135		Graft versus host reaction 152	
17. Hypersensitivity	137	Foetus as a graft 152	
Type I hypersensitivity: Anaphylactic 137		Tumour immunology 152	
		20. Immunohaematology	156

Section 2: Systemic Bacteriology

21. Staphylococcus	163	30. Mycobacterium leprae	239
<i>Staphylococcus aureus</i> 163		<i>Mycobacterium lepraemurium</i> 245	
Coagulase-negative staphylococci 168		31. Non-sporing Anaerobes	247
Other coagulase-negative staphylococci 169		Bacteroidaceae 249	
22. Streptococcus and Enterococcus	172	32. Spirochaetes	252
Classification 172		<i>Treponema</i> 252	
23. Streptococcus pneumoniae (Pneumococcus)	183	<i>Treponema pallidum</i> 253	
24. Neisseria, Moraxella and Acinetobacter	189	Non-venereal treponematoses 259	
<i>Neisseria meningitidis</i> (meningococcus) 189		<i>Borrelia</i> 260	
<i>Neisseria gonorrhoeae</i> (gonococcus) 192		Relapsing fever 260	
Non-gonococcal urethritis (NGU) 195		<i>Borrelia vincentii</i> 261	
<i>Kingella</i> 195		<i>Borrelia burgdorferi</i> 261	
<i>Moraxella</i> 195		<i>Leptospira</i> 262	
<i>Acinetobacter</i> 196		<i>Leptospira interrogans</i> 262	
25. Corynebacterium	199	33. Enterobacteriaceae: Escherichia, Klebsiella and Other Genera	267
<i>Corynebacterium diphtheriae</i> 199		34. Proteus, Morganella and Providencia	279
Non-diphtheria corynebacteria (diphtheroids) 204		35. Shigella	283
26. Bacillus	207	36. Salmonella	288
<i>Bacillus anthracis</i> 207		37. Yersinia	298
<i>Bacillus cereus</i> 209		38. Vibrio, Aeromonas and Plesiomonas	304
27. Clostridium	212	Halophilic vibrios 309	
<i>Clostridium perfringens</i> (<i>Clostridium welchii</i>) 212		39. Campylobacter, Helicobacter and Spirillum	314
<i>Clostridium difficile</i> 216		<i>Campylobacter</i> 314	
<i>Clostridium tetani</i> 216		<i>Helicobacter</i> 316	
<i>Clostridium botulinum</i> 219		<i>Spirillum minus</i> 317	
28. Mycobacterium tuberculosis	223		
<i>Mycobacterium tuberculosis</i> complex 223			
29. Non-tuberculous Mycobacteria	235		

40. <i>Pseudomonas</i> and <i>Burkholderia</i>	319	Coxiellaceae 354	
41. <i>Legionella</i>	325	Bartonellaceae 355	
42. <i>Haemophilus</i>	328	47. <i>Chlamydia</i> and <i>Chlamydophila</i>	358
Other haemophili 331		48. <i>Actinomycetes</i>	364
43. <i>Bordetella</i>	334	49. <i>Miscellaneous Bacteria</i>	369
44. <i>Brucella</i>	339	50. <i>Automation in Microbiology</i>	377
45. <i>Mycoplasma</i> and <i>Ureaplasma</i>	344	1. Automated specimen processing 378	
Atypical pneumonia 348		2. Automated identification and antimicrobial susceptibility testing systems 378	
46. <i>Rickettsia</i>, <i>Orientia</i>, <i>Ehrlichia</i>, <i>Anaplasma</i>, <i>Neorickettsia</i>, <i>Coxiella</i> and <i>Bartonella</i>	350	3. Molecular automation 380	
Rickettsiaceae 350		4. Total laboratory automation (TLA) 381	
Anaplasmataceae 354		5. Proteomic-based automated identification system 381	
		Criteria for evaluation and selection of automated system 381	

Section 3: Virology

51. General Properties of Viruses	385	57. Picornaviruses	429
Structure of the viruses 385		Enteroviruses 429	
Shape 386		Rhinoviruses 432	
Susceptibility to physical and chemical agents 386		Hepatovirus (hepatitis A virus) 433	
Viral haemagglutination 387		58. Rhabdoviruses	435
Replication of viruses 387		Rabies virus 435	
Virus isolation 390		Vesiculovirus 439	
Viral assay 392		59. Orthomyxoviruses	441
Viral genetics 393		60. Paramyxoviruses	447
Nomenclature of viruses 394		Parainfluenza, mumps and measles viruses 447	
Classification of viruses 394		61. Caliciviruses, Astroviruses and Coronaviruses	452
52. Virus–Host Interactions, Laboratory Diagnosis of Viral Infections, and Viral Vaccines	399	Caliciviruses 452	
Transmission of human virus infections 400		Astroviruses 452	
Host response to virus infection 401		Coronaviruses 452	
Laboratory diagnosis of viral infections 402		62. Arboviruses	455
Viral vaccines 403		Togaviridae 456	
Antiviral therapy 404		Alphaviruses 456	
53. Bacteriophage	407	Rubella virus 457	
54. Poxviruses	410	Flaviviridae 458	
55. Herpesviruses	414	Bunyaviridae 461	
Herpes simplex virus (HSV) 414		63. Filoviruses, Arenaviruses and Reoviridae	465
Varicella-zoster virus (VZV) 416		Filoviruses 465	
Epstein-barr virus (EBV) 417		Arenaviruses 465	
Cytomegalovirus (CMV) 419		Reoviridae 466	
Human herpesvirus 6 420		64. Human Immunodeficiency Virus: AIDS	469
Human herpesvirus 7 420		Human immunodeficiency viruses 469	
Human herpesvirus 8 420		65. Hepatitis Viruses	481
Cercopithecine herpesvirus 1 420		Hepatitis A virus (HAV) 481	
56. Adenoviruses, Parvoviruses, Papillomaviruses and Polyomaviruses	423	Hepatitis B virus (HBV) 482	
Adenoviruses 423		Hepatitis C virus (HCV) 486	
Parvoviruses 424		Hepatitis D virus (HDV) 487	
Papillomaviruses and polyomaviruses 425			

Hepatitis E virus (HEV) 488
 Hepatitis G virus (HGV) 488
 SEN virus (SEN-V) 489
 Transfusion-transmitted virus (TTV) 489

66. Oncogenic (Tumour) Viruses 492

Oncogenic DNA viruses 494
 Oncogenic RNA viruses 494

67. Slow Virus Infections and Prions 496

Slow virus infections 496
 Prions 497

Section 4: Medical Mycology

68. Medical Mycology 503

Classification of fungi 504
 Laboratory diagnosis of mycoses 504
 Classification of mycoses 506
 I. Superficial mycoses 507
 II. Subcutaneous mycoses 511

III. Systemic mycoses 517
 IV. Opportunistic mycoses 521
 Superficial infections 521
 Deep infections 523
 Disseminated candidiasis and candidemia 523
 V. Miscellaneous mycoses 530

Section 5: Clinical Microbiology

69. Emerging and Re-emerging Infectious Diseases 539

70. Infective Syndromes 542

71. Nosocomial Infections 550

Antibiotic policy 551

72. Antimicrobial Sensitivity Testing 554

73. Prophylactic Immunization 560

Section 6: Bacteriology of Water, Milk and Air, and Biological Warfare

74. Bacteriology of Water, Milk and Air 565

Bacteriology of water 565
 Bacteriology of milk 567
 Bacteriology of air 568

75. Biological Warfare 571

Hippocratic oath 571

Section 7: Quality Assurance, Ethics and Overview of Microbiology

76. Quality Assurance in Microbiology Laboratory 581

77. Ethics in Laboratory Medicine 587

78. Overview of Microbiology 589

Index 595